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Precambrian Geology of the Burleigh Falls Area

Peterborough County
Southern Ontario

1988

Ministry of
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and Mines

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Precambrian Geology of the Burleigh Falls Area

Peterborough County, Southern Ontario

by

E.G. Bright

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V.G. Milne

V.G. Milne, Director
Ontario Geological Survey

Foreword

Prior to the initiation of the present project parts of the Burleigh Falls Area had never been mapped in detail and no modern general compilation existed for it. The investigation was designed to study specific portions of the area in detail, to attempt a regional geological synthesis and to provide a mineral potential evaluation.

The Precambrian bedrock of the area hosts occurrences of industrial minerals such as nepheline, phlogopite, vermiculite, feldspar and mica. One nepheline deposit is being operated presently. Several economically interesting uranium occurrences also exist in the study region.

V.G. Milne
Director
Ontario Geological Survey

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ABSTRACT

The Burleigh Falls area is situated about 45 km southwest of Bancroft and covers about 1000 km^2 in the northeastern part of Peterborough County, Ontario. Middle Proterozoic rocks underlie most of this map area which straddles the southwestern margin between the Middle Proterozoic Central Metasedimentary Belt of the Grenville Province and the flat-lying Paleozoic sediments of the St. Lawrence marine shelf.

The area is structurally dominated by the Burleigh gneiss dome, a 13 km wide, elliptical centre of basement uplift and granitic emplacement at the southern end of the Harvey-Cardiff Basement Arch. Between Bancroft and Burleigh Falls, this 80 km long and 25 km wide, northeast-trending arch contains a linear series of five structural domes. The Burleigh Dome is the most

southern dome within the arch.

Middle Proterozoic epiclastic metasediments of the Grenville Supergroup disconformably overlie a locally exposed and older Middle Proterozoic basement migmatite-gneiss complex in the southwestern part of the Burleigh Dome. Along the flanks of this dome, metasediments and locally metavolcanics of the supergroup have been uplifted and folded around and between this dome and the adjacent Anstruther Dome to the north of the area. To the east and west of these domes, the folded and locally cross-folded rock of the Supergroup form southwesterly plunging synclinoria that parallel the Harvey-Cardiff Basement Arch.

The Grenville Supergroup has a estimated, cumulative thickness of between 4,000-4,500 m. It is subdivided into three major lithostratigraphic subdivisions which in ascending order are: 1) the meta-arenite-rich Anstruther Lake Group; 2) the metavolcanic rock-rich Hermon Group; and 3) the marble-rich Mayo Group.

These rocks together with a wide variety of early to syntectonic alkalic, mafic, and felsic plutonic rocks were subjected first to the Elzevirian Orogeny, between 1240-1180 Ma and later the Grenville Orogeny between 1140 - 1000 Ma.

During the waning stages of the Grenville Orogeny, swarms of late tectonic pegmatitic granite dikes were emplaced into the deformed rocks of the Supergroup mainly along the flanks of the Burleigh Dome. Along the northern flanks of this dome, alteration zones in some of these pegmatitic bodies contain uranium mineralization. These pegmatite-hosted uranium deposits form the southern part of the Bancroft uranium belt. This belt structurally coincides with the Harvey-Cardiff Basement Arch.

PRECAMBRIAN GEOLOGY
OF THE
BURLEIGH FALLS AREA

Peterborough County, Southern Ontario

by

E.G. Bright[1]

INTRODUCTION

The Burleigh Falls area which covers about 1,000 km^2 in the northeastern part of Peterborough County lies approximately 45 km southwest of the Town of Bancroft, and 35 km north of the City of Peterborough. The map area is bounded by Longitudes 78°00' and 78°30'W and by Latitudes 44°30' and 44°45'N. It includes parts of Galway, Cavendish, Anstruther, Chandos, Harvey, Burleigh, Methuen, Smith and Dummer Townships. The village of Apsley lies just to the north of the northeast corner of the area; the villages of Burleigh Falls and Buckhorn lie in the southern part of the area.

MEANS OF ACCESS

Primary access from the east is via Highway 28, north from Peterborough through Burleigh Falls northward across the eastern part of the area to Apsley. Secondary roads off Highway 28, near Apsley provide ready access to Anstruther Lake and Jack Lake in the northeastern part of the area.

Road access into the southeastern part of the area is provided by a new secondary road east from Highway 28 at Woodview that winds

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along the north shore of Stoney Lake towards Nephton. The south central and western part of the map area is accessible via Highway 36 west to Buckhorn, then north along Highway 507 to Mississauga and Catchacoma lakes in the northwestern part of the area. Buckhorn can also be reached via Highway 28, north from Peterborough to Highway 507 near Lakefield.

Alternative access into the western part of the map-area is via Highway 36 northeast from Lindsay to Bobcaygeon. East of Bobcaygeon, Highway 36 connects with Highway 507 approximately 8 km north of Buckhorn.

Secondary recreation and logging roads extending from these highways provide good access to most of the larger lakes in the area, especially the Pigeon-Stoney Lake segment of the Trent-Severn Water System which traverses the southern part of the area.

Access into the central part of the map-area, the region of the Burleigh Falls Gneiss Dome is limited to a system of canoe routes.

PROSPECTING AND MINING ACTIVITY

Prospecting in the area was originally sparked during the latter part of the 19th century by the discovery of corundum and mica in the alkalic syenite gneisses of the Bancroft region. Since that time prospecting has been carried out at various localities on deposits of mica, feldspar, nepheline, iron and corundum.

In the 1930's, companied involved in the glass and ceramic industry, again explored the nepheline-syenitic rocks of the area. In 1932 and 1933, William Morrison prospected and staked part of the Blue Mountain Nepheline Syenite Complex in Methuen Township. Commercial development of nepheline syenite at Blue Mountain, near Nephton, commenced by open-pit mining methods in 1936. Nepheline Syenite production from this area has continued uninterrupted to the present day. Output in 1980 was from two major producers: Indusmin Limited (in the map area) and Sobin Chemicals (Canada) Limited (just to the east of the map area). Between 1943 and 1970, the Indusmin Limited property milled approximately 5,007,000 tons of nepheline syenite.

Since the 1950's most of the exploration has been concentrated on and near the numerous uranium deposits in the northern part of the area. Periods of peak activity occurred during the mid-1950's, the late 1960's and the late 1970's. Production feasibility studies were carried out in the late 1970's by Rare Earth Resources Limited and Imperial Oil Limited on the Cavendish uranium deposit, and by Camindex Mines Limited on the Zenmac-Loon Call Lake uranium deposit.

In 1974-1979, Insulite Development Corporation Incorporated tested a phlogophite-vermiculite deposit in weathered marbles in southern Cavendish Township.

PRESENT GEOLOGICAL SURVEY

The northern part of the area, Anstruther and Cavendish Township were mapped in detail by the author during the summers of 1975 and 1976. Wherever possible, pace-and-compass traverses were run perpendicular to the regional trend and were spaced approximately 400 m apart. The geological field data were plotted on acetate sheets overlain on aerial photographs at a scale of 1 inch to 1/4 mile. These data were then transferred to a base map at the same scale prepared by the Cartography Section, Surveys and Mapping Branch, Lands and Waters Group from maps of the Forestry Resources Inventory.

Uncoloured preliminary Maps P.2420-P.2423 (Bright 1981a to 1981d) at a scale of 1 inch to 1/4 mile were published for the northern and southern parts of Cavendish and Anstruther Townships. Supplementary reconnaissance mapping of these same, two townships was carried out in 1977 during preparation of the Eels Lake area synoptic compilation sheet. The Eels Lake area uncoloured preliminary Map P.2205 (Bright 1980) at a scale of 1 inch to 1 mile (1:63,360) was published after this regional study.

The southern part of the Burleigh Falls area, together with some areas in the northern part, particularly southern Galway and Chandos Townships, was mapped in reconnaissance fashion by the author during the summer of 1980. Areas of particular interest such as the Cavendish-Harvey metavolcanic rocks in Harvey Township and the Stoney Lake metavolcanic rocks in Burleigh Township as well as the southern and northeastern parts of the Burleigh Dome, were mapped in greater detail. Areas underlain by Paleozoic rocks are shown on the map, but were not examined in any detail. Reconnaissance mapping was carried out along all road access routes and most of the major waterways throughout the region. The geological field data was plotted in the manner as outlined above, however, these data were then transferred to a base map at a scale of 1:50,000m (Map P.3096, back pocket).

PREVIOUS GEOLOGICAL WORK

Willet G. Miller (1899, pt.2, p.206-17), Provincial Geologist of Ontario was the first to describe many of the nepheline syenite occurrences of the Bancroft-Renfrew area and Methuen Township. Adams and Barlow (1910) of the Geological Survey of Canada carried out reconnaissance mapping throughout the region and described the area in their memoir "Geology of the Haliburton and Bancroft areas". Satterly (1943) carried out reconnaissance geological mapping of parts of the area during a detailed study of the mineral occurrences of the Haliburton region. Following this study, Satterly (1957) as part of an uranium study in the Bancroft area, examined and collected data on most of the uranium deposits in the area. D.F. Hewitt (1957b) published a regional compilation of the Haliburton-Bancroft area at a scale of 1 inch to 2 miles which includes the map-area. Hewitt (1961) also carried out detailed mapping of Methuen Township and described the geology of this township in his report on the "Nepheline Syenite Deposits of Southern Ontario".

More recently, Shaw (1962) carried out detailed geological mapping of Chandos Township and Morton (1983) conducted a similar program for the Ontario Geological Survey in Harvey Township.

The Paleozoic geology of the southern part of the area has been described by Liberty (1969), and Carson (1980).

PHYSIOGRAPHY

The Burleigh Dome dominates the physiography of the central part of the map area. This 13 km wide elliptical region of high bedrock exposure, in places up to 50 percent, has an average elevation of 330 m above sea level and a maximum elevation of 350 m in the northern part of the dome in northeastern Harvey and northwestern Burleigh Townships. North and northwest of the Burleigh Dome in southern Cavendish and Anstruther Townships, the elevation averages about 330 m but increases steadily northward as the flanks of the Anstruther Dome in the adjacent map area are approached. Both these domical areas are characterized by rolling rocky ridges separated by small lakes and narrow elongated swampy areas.

North of Pigeon and Stoney Lakes, which form part of the Trent-Severn Drainage systems, the regions of lowest elevation underlain by Precambrian rocks occur immediately east and west of the Burleigh Dome. To the east of this dome the broad Eels Creek-Jack Creek drainage basin is underlain predominantly by marble. This region of poorly exposed bedrock averages about 280 m above sea level. To the west of the Burleigh Dome, the much narrower Mississauga-Squaw River drainage system is underlain mainly by metavolcanic rocks. Bedrock exposure is better than in regions underlain by marble and the average elevation is about 300 m above sea level.

These two major drainage systems drain southward into the Trent-Severn River system which in this area marks the sinuous boundary between the flat-lying Paleozoic rocks and the crystalline rocks of the Precambrian Shield.

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During the 1975 field season, the author was ably assisted

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During the synoptic mapping and compilation of the adjacent Eels Lake area in 1977, the author was assisted by D. Westlake, and in 1980, W. Seims assisted during the synoptic mapping and compilation of the Burleigh Falls area.

GENERAL GEOLOGY

The Burleigh Falls area lies along the southwestern exposed margin of the Middle Proterozoic Central Metasedimentary Belt (Wynne-Edwards 1972) which forms the southern part of the Grenville Province of southeastern Ontario.

The map-area is dominated by the 13 km wide, elliptical Burleigh Dome. This gneiss dome forms the southern part of the Harvey-Cardiff Basement Arch, an 80 km long and 25 km wide linear zone of 5 structural domes between Burleigh Falls and Bancroft. The dome is composed of an older Middle Proterozoic basement migmatite-gneiss complex exposed in the southcentral region of the dome. Subhorizontal to subvertical dipping epiclastic metasediments of the Grenville Supergroup mantle the Burleigh Dome and unconformably overlie the basement complex. Along the flanks of the dome, the rocks of the Grenville Supergroup together with early to syntectonic suites of mafic and alkalic sills have been uplifted, isoclinally folded and cross-folded.

The Grenville Supergroup, which has a composite thickness of 4,000-4,500 m has been subdivided by the author into three major lithostratigraphic subdivisions. In ascending order they are, the Anstruther Lake, Hermon and Mayo Groups. The basal Anstruther Lake Group consists mainly of feldspathic meta-arenite with subordinate metawacke and minor para-amphibolite.

The Hermon Group conformably overlies the Anstruther Lake Group and consists of a lower sequence of epiclastic and chemical (marble) metasediments, and an upper sequence of metavolcanics and minor metasediments. In the western part of the area, the metavolcanics form a 2500-2800 m thick, tholeiitic mafic to felsic suite. In the eastern part, they form thinner, 900-1100 m thick, tholeiitic and calc-alkaline mafic to felsic suites.

The Mayo Group conformably overlies the Hermon Group and consists mainly of carbonate metasediments with subordinate epiclastic metasediments concentrated towards the top of the group.

Intruding the supracrustal sequence of the Grenville Supergroup is a variety of small Middle Proterozoic mafic, alkalic, and felsic plutonic rocks. Along the southern boundary of the map area, these rocks are unconformably overlain by flat lying Cambro-Ordovician and Middle Ordovician limestones and sandstones of the St. Lawrence Paleozoic Platform. The lithological units of the Burleigh Falls map area are listed in Table 1.

The map area was subjected to at least two major periods of deformation accompanied by regional metamorphism between approximately 1,250 Ma and 1,000 Ma (Stockwell 1982). During the early stages of the 1240 to 1180 Ma Elzevirian Orogeny, (Stockwell 1982) the relatively flat-lying Grenville Supergroup was intruded by early tectonic suites of mafic and sodic to potassic alkalic bodies which included the Blue Mountain Nepheline Syenite Complex. All the above rocks were subsequently deformed and regionally metamorphosed during the emplacement of a syntectonic suite of granodioritic to granitic plutons. This suite is probably related to the 1226 ± 25 Ma Elzevir Batholith (Lumbers 1967a and b, Stockwell 1982) in the Madoc region to the east of the map area.

Between 1140 Ma and 1000 Ma (Stockwell 1982) all these rocks were subjected to the Grenville Orogeny. This younger orogeny was accompanied by renewed uplift, granitic intrusion, regional folding, thrust faulting, and by high rank metamorphism to upper amphibolite facies conditions.

At successive stages during and after the culmination of this high metamorphic rank event, the following plutonic rocks were emplaced, in approximate order of decreasing age: (1) massive to weakly foliated granite to locally granodiorite stocks and dikes; (2) small mafic dikes of probably more than one age; and (3) swarms of small late tectonic pegmatitic granite dikes, which in places along the margins of the Burleigh Dome, contain important concentrations of uranium mineralization.

Many of the rocks of the area are fractured and sheared. Three regional fault systems occur in the area and trend, in probable order of decreasing age, east-northeast, northeast and north to northwest respectively.

PRECAMBRIAN

MIDDLE PROTEROZOIC

BASEMENT MIGMATITE-GNEISS COMPLEX

In northwestern Harvey Township, a series of grey and pinkish grey migmatites and gneisses (unit 1) which the author has interpreted as basement to the Grenville Supergroup are exposed in a 7 km long oval-shaped area to the north of the village of Buckhorn in the southwestern part of the 13 km wide, elliptical Burleigh Dome. This dome (feature No. 1, Figure 7) forms the southern part of the 80 km long Harvey-Cardiff Basement Arch, a northeasterly-trending, linear series of five structural domes in the western part of the Central Metasedimentary Belt. These domes were selective centers of basement uplift and related granitic intrusion (Bright 1980). During this reconnaissance mapping survey, the author did not examin these migmatites and gneisses in the southwestern region of the Burleigh Dome, however these rocks were mapped earlier in detail by Morton (1983) at a scale of 1:15 840. During this survey, the author did examine at selective locations the various, pink and buff-coloured metasedimentary gneisses (units 2 and 3) surrounding this inferred basement complex in the core region of the Burleigh dome. Prior to this survey, the author mapped in detail these same metasedimentary gneisses along the northern flanks of the Burleigh Dome in Cavendish and Anstruther Township as well as their folded equivalents along the flanks of the adjacent Anstruther Dome to the north in the Eels Lake area (Bright 1980, 1981a to d). A basement migmatite-gneiss complex is exposed in the core region of the Anstruther Dome (Bright 1980).

The author's proposed basement migmatite-gneiss complex, in general corresponds to the area which Morton (1983) designated as the central migmatite zone of his "Burleigh Gneiss Complex". He classified these rocks as mottled, pink and grey, in places pinkish grey feldspar-quartz-biotite layered and nebulitic migmatites containing local zones of homogeneous, migmatitic granodiorite. Encircling his central migmatite zone and forming the margins of the complex is a complex marginal zone of banded quartz-feldspar gneisses. In places these rocks are described as gradational with rocks of his central migmatite zone. Morton (1983) describes these banded gneisses as consisting predominately of pink and buff coloured, banded, fine- to medium grained, biotite-quartz-feldspar gneisses and locally dark grey mafic gneisses which, in places exhibit relict bedding, graded bedding and crossbedding. The author has reinterpreted all the rocks of Morton's marginal zone as strongly foliated to locally migmatitic feldspathic meta-arenites and metawackes of the Anstruther Lake Group (Bright 1980, 1981c and d).

Supportative evidence for the author's reinterpretation of the rocks of Morton's (1983) "Burleigh Gneiss Complex" is found not only in the many striking similarities in lithologies and stratigraphy of the Burleigh Dome to the Anstruther Dome but also in the magnetic responses and patterns of both domes on the aeromagnetic Map 146G (GSC 1953, scale 1:63360). On this map, the much higher magnetic response and closely spaced contours in areas underlain by the magnetite-bearing meta-arenites of the Anstruther Lake Group compared to the response of the basement complex in the core region of this dome was very useful in delineating the basement-cover contact in the Anstruther Dome (Bright 1980). The same contrasting magnetic, response feature between the Anstruther Lake Group and the basement migmatite-gneiss segment can be seen on this same aeromagnetic map in the southwestern region of the Burleigh Dome, to the north of the village of Buckhorn in Harvey Township.

METASEDIMENTARY AND METAVOLCANIC ROCKS

GRENVILLE SUPERGROUP

INTRODUCTION

In southeastern Ontario, Middle Proterozoic metasediments and metavolcanics of the Grenville Supergroup underlie most of the Central Metasedimentary Belt (Wynne-Edwards 1972) of the Grenville Province. This belt (Figs. 2 and 7) lies to the southeast of an older Middle Proterozoic gneiss complex, which is referred to in the north Bancroft area as the Algonquin Gneiss Complex (Lumbers 1980). This complex is separated from the Central Metasedimentary Belt (CMB) by a major northeast-trending tectonic zone (Figs. 2 and 7) containing fault-bounded segments of Grenville Supergroup rocks interleafed in the older cataclastically deformed gneisses.

The Grenville Supergroup rocks are younger than the Ca 1,430 m.y. old rocks (Bell and Blekinsop, 1980) of the "Algonquin Gneiss Complex" exposed near Barrys Bay to the north of the map area and older than the Ca 1,226 m.y. old (Silver and Lumbers,

1966) Elzevir and related Weslemkoon granodioritic plutons that intrude the Supergroup east of the map area (Figure 7).

Previous mapping to the north, along the central and northern parts of the Harvey-Cardiff Basement Arch in the Eels Lake area (Bright 1980, 1983) and the Center Lake area (Bright 1979, 1983) respectively provided the basis for a lithostratigraphic subdivisions of the Grenville Supergroup in the Burleigh Falls area. In ascending stratigraphic order, these regional subdivision, as shown on the accompanying map (back pocket) are the Anstruther Lake Group (Bright 1979, 1980), the Hermon Group (Lumbers 1967b) and the Mayo Group (Hewitt and James, 1956). Within these three major subdivisions, most individual units still require more detailed study to be further stratigraphically subdivided. Therefore the order of the subdivisions within the groups as shown on the map (back pocket) and in the Table of Contents (Table 1) is tentative and does not imply age relationships.

The Anstruther Lake Group, the lowest exposed portion of the Grenville Supergroup in the Bancroft-Burleigh Falls area (Bright 1979, 1980), consists mainly of feldspathic, arenaceous metasediments with subordinate interbedded units of biotite-rich metasediments. In the map area (area No. 4, Fig. 2) the coarse, locally migmatitic, epiclastic sequence unconformably overlies a basement migmatite-gneiss complex exposed in the Burleigh Dome (No. 1, Fig. 7). In the Eels Lake area (area No. 1, Fig. 2), to the north same group, this unconformably overlies a basement complex exposed in the central region of the Anstruther Dome (No. 2, Fig. 7).

During an earlier stratigraphic study of the Grenville

Supergroup to the east in the Bancroft-Madoc area (area No. 1, Fig. 2), Lumbers (1967a and b, 1969) defined the metavolcanic rock-rich Hermon Group as thelowest part of the Grenville Supergroup in that region. These metavolcanics, which have been intruded by the Elzevir Pluton, were dated at 1,310±15 Ma by Silvers and Lumbers (1966); this date has subsequently been recalculated to 1,286±15 Ma by Bell and Blenkinsop (1979). Subordinate epiclastic metasediments are intercalated with these metavolcanics. Lumbers (1967b) redefined a second group, the marble-rich Mayo Group after Hewitt and James (1956). Lumbers interpreted the Hermon and Mayo Groups as major lithostratigraphic subdivisions of the Grenville Supergroup and considered them to be roughly age-equivalent. According to him, the groups have a combined maximum thickness of 9,000 metres north of Madoc (area No. 1, Fig. 2).

In the map area, as well as in the adjacent Eels Lake area, (area No. 2, Fig. 2) the Hermon Group consists predominantely of epiclastic metasediments with subordinate metavolcanics and marble. These rocks conformably overlie the feldspathic, arenaceous metasediments of the Anstruther Lake Group. Conformably overlying the Hermon Group strata, in this same region is a thick marine sequence of Mayo Group carbonate metasediments containing minor interstratified units of epiclastic metasediments. In the western part of the map area the Supergroup is approximately 4,000 metres and in the eastern part in excess of 4,500 metres thick. In the Eels Lake area to the north, an estimated maximum cumulative thickness of the Grenville Supergroup is approximately 3,600 metres (Bright 1980).

ANSTRUTHER LAKE GROUP

INTRODUCTION

The Anstruther Lake Group represents the lowest portion of the Grenville Supergroup in the Burleigh Falls area. This group was previously named by the author (Bright 1976, 1977, 1980) after the shallow-dipping and locally migmatitic epiclastic metasediments exposed in the 40 meter high cliffs along the northeast shore of Anstruther Lake in Anstruther Township. This type section lies less than 2 km to the north of the map area in the adjoining Eels Lake area (Bright 1980).

Throughout the Burleigh Falls and adjacent Eels Lake area, the Anstruther Lake Group consists of feldspathic, arenaceous metasediments with subordinate interbedded units of biotite-rich metasediments all of which in many places are migmatitic. Foliated, in places stromatic migmatite phases of both these major metasedimentary lithologies are locally abundant, particularly near the basement/cover contact zones in the Anstruther and Burleigh Domes. Amphibole-rich metasediments are rare and carbonate metasediments are absent in this group. This sequence dips shallowly to subvertically and mantles most of the Burleigh Dome.

In the map-area, the Anstruther Lake Group has an estimated composite maximum thickness in excess of 1,500 m, compared to 900-1,000 m for the group to the north in the adjacent Eels Lake area.

During the present survey, Anstruther Lake Group metasediments were examined along the flanks of the Burleigh Dome. The lithologies of the group are described below. For a more detailed account the reader is referred to the report on the Eels Lake area (Bright, in press).

EPICLASTIC METASEDIMENTARY ROCKS AND RELATED MIGMATITES

FELDSPATHIC ARENACEOUS METASEDIMENTS

Foliated, in places layered, and migmatitic feldspathic arenaceous metasediments (map-unit 2) comprise over 60 percent of the Anstruther Lake Group. Interlayered with these rocks are minor units of biotite-quartz-plagioclase gneiss (metawacke), thinly laminated units of biotite schist (metamudstone) and in places para-amphibolite. Feldspathic arenaceous metasediments (map unit 2a) are predominantly medium to coarse grained, foliated, in places layered, pink to pinkish-grey, biotite quartzofeldspathic gneiss (feldspathic meta-arenite) containing less than 10 percent biotite and occasionally minor hornblende. The rocks are granoblastic to locally porphyroblastic and are composed of quartz, microperthitic microcline and microcline, sodic plagioclase. Potassic and sodic feldspars are present in approximately subequal amounts. Accessory magnetite, in places up to 5 percent, is characteristic of these feldspathic meta-arenite. Accordingly the Anstruther Lake Group as a whole, because of its magnetite content, can be distinguished on the aeromagnetic Map 103G (GSC-1953). Most exposures display prominent compositional layering reflecting in part the original bedded nature of the rocks, and in part a layering which is of migmatitic origin, developed during metamorphism and deformation (Photo I). Thin units of discontinuous interlayered granitoid leucosome, usually less than 10 cm thick generally comprise less than 10 percent of a migmatitic outcrop (Photo 2). Large exposures of feldspathic meta-arenite appear to be medium to thickly-bedded. Marked variations in biotite content aid the observer in delineating the relict compositional layering in outcrops devoid of metawacke interbeds. Intercalated sequences of feldspathic meta-arenite and metawacke tend to be thin to medium (3 to 30 cm) bedded (Photo 2).

In most regions examined along the northern and eastern flanks of the Burleigh Dome, recrystallization and migmatization has not obscured the primary layering but it has destroyed most small-scale primary features. Along Highway 36 to the west and on Long Lake to the north of Burleigh Falls, migmatitic the feldspathic meta-arenites are predominately foliated to layered, in places stromatitic migmatitic quartzofeldspathic gneiss (map unit 2b). In this region, the Anstruther Lake Group metasediments are cut by numerous concordant to discordant syntectonic to late tectonic granitic dikes (map-units 19, 21 and 23 respectively).

In contrast to the above, the Anstruther Lake Group feldspathic meta-arenites exposed along the western and southwestern flanks of the dome are less deformed and primary bedding is preserved in many outcrops. Relict features such as graded bedding and cross-laminations are locally prominent in exposures: (1) along Highway 36 north of Lovesick Lake and north of Deer Bay on Lower Buckhorn Lake to the east of the village of Buckhorn; (2) north of Buckhorn on Highway 507°, and (3) to the west of the Mississagua River, and west of Buckhorn on Big Bald Lake.

BIOTITE-RICH METASEDIMENTS AND RELATED MIGMATITES

Foliated, commonly layered, and in places, migmatitic biotite- rich metasediments (unit 3) comprise over 30 percent of the Anstruther Lake Group. They occur interlayered with the more abundant feldspathic meta-arenites in most regions of the Burleigh Dome. The biotite-rich metasedimentary units many of which are generally too small to be shown separately on the map appear to be concentrated toward the stratigraphic top of the group along the flanks of the Buckhorn anticline in the southwestern part of the Burleigh Dome.

The rocks of map unit 3a are predominantly fine- to medium-grained, foliated, commonly layered, light to dark grey biotite-quartz-plagioclase gneiss (metawacke) and subordinate hornblende-biotite-quartz-plagioclase gneiss (calcareous metawacke). These metawackes contain more than 10 percent biotite and subordinate hornblende. Minor compositional variations include biotite-quartz-feldspar schist (metamudstone) containing more than 50 percent biotite, and biotite-hornblende-quartz-plagioclase gneiss (calcareous metamudstone). Garnet locally occurs in the schists and hornblende generally forms porphyroblasts in the gneiss. In these same metawackes, local mafic mineral-rich lamallae and porphyroblasts and porphyroclasts of quartz and plagioclase parallel and accentuate the foliation and compositional layering.

Most metawacke is thin to medium bedded (3-30 cm). Migmatization effects are commonly more pronounced in these rocks than in adjacent units of feldspathic meta-arenite, for example in the roadcuts along Highway 36 west of Burleigh Falls. In some of the larger units of biotite-rich metasediments exposed along this section of highway, all gradiations from foliated and layered metawacke to stromatic biotitic migmatite (Photos 3 and 4), nebulitic biotitic migmatite, and locally schollen textured, biotitic migmatite (unit 3b) can be observed over short distances. In contrast the Anstruther Lake Group feldspathic meta-arenites along Highway 507 north of Buckhorn and along Highway 36 east of Buckhorn, contain interlayered units of metawacke displaying relict primary bedding, grain gradation, and scour-and fill structures.

HERMON GROUP

INTRODUCTION

In the map area, the Hermon Group contains the following two major assemblages:

(1) a lower sequence of predominantly epiclastic metasediments with subordinate intercalated marble.

(2) an upper sequence of mafic to felsic metavolcanics containing minor intercalated epiclastic metasediments and marble.

In the north and western part of the map area, along the northern and western flanks of the Burleigh Dome in southern Cavendish, southeastern Galway and north central Harvey Townships, Hermon Group metasediments and metavolcanics form tightly folded and, in places, refolded sequences. To the north in the adjacent Eels Lake area (Bright 1980), the Hermon Group conformably overlies the Anstruther Lake Group, however, in the northern and northwestern part of the map-area most contacts between these two groups are faults. In the southwestern part of the map area near Big Bald and Sandy Lakes the lower epiclastic metasedimentary sequence of the Hermon Group conformably overlies Anstruther Lake Group feldspathic meta-arenites. The boundary between these groups has been chosen where marble first appears or, if this rock type is absent, where individual or intercalated units of metawacke, para-amphibolite and aluminous metapelite become prominent. Along the northern flank of the Burleigh Dome, between Beaver, Gold, Crab and Anstruther Lakes some of the Hermon Group feldspathic meta-arenites and metawackes are locally migmatitic. In the northwestern part of the map-area, i.e. southwestern Cavendish Township, the Hermon Group has an estimated composite thickness of 2,500 - 2,800 m. Along strike to the south in the western part of the area, i.e. northcentral Harvey Township, the lower epiclastic-chemical sequence is absent and the group consists predominantely of metavolcanic and has a composite thickness of about 1,800 to 2,200 m.

In the eastern part of the map area, a lithologically similar but thinner sequence of Hermon Group metavolcanics and subordinate intercalated metasediments is exposed along the fault-bounded, eastern flank of the Burleigh Dome in western Burleigh Township. Local infolding of Hermon Group metasediments in the Anstruther Lake Group rocks occurs locally at the northeastern end of this dome. Along the eastern flank of the dome, the Hermon Group strata dip easterly beneath the structurally overlying Mayo Group marbles in the adjacent, 10.5 km wide, cross-folded Chandos synclinorium (Bright, in press). In the southeastern part of the map area, along the southern margin of this synclinorium, Hermon Group metavolcanics and subordinate metasediments outcrop in a narrow easterly-trending belt through Stoney Lake. Here the group conformably underlies Mayo Group marbles and has an estimated composite thickness of 800-1,000 m. Further east in Methuen Township, to the east of the map area, the Hermon Group thickens appreciably along the eastern margin of this synclinorium.

The major lithologies of the Hermon Group are described below. A more detailed description of the Hermon Group epiclastic metasediments in Cavendish and Anstruther Township is contained in the report on the Geology of the Eels Lake area (Bright, in press).

EPICLASTIC METASEDIMENTARY ROCKS

FELDSPATHIC ARENACEOUS METASEDIMENTS

In the northern and east-central parts of the area, feldspathic arenaceous metasediments (unit 4), derived mainly from feldspathic arenite are the second most abundant rock-type after biotite-rich metasediments (unit 5) in the lower metasedimentary part of the Hermon Group. Here they occur: (1) along the northern flank of the Burleigh Dome and the southern flank of the adjacent Anstruther Dome in southeast Caendish and southern Anstruther Townships; (2) within the northeastern part of the Burleigh Dome and along the eastern flank of this dome in northwest Burleigh Township; and (3) to the west of the Burleigh Dome near Lavery lake in southeast Galway and northwest Harvey Townships.

These feldspathic metarenites (unit 4a) are mainly fine- to medium-grained, foliated, in places layered, pink to pinkish-grey, biotite- and muscovite-biotite-quartz-feldspar gneisses. The plagioclase content is usually greater than or equal to potassic feldspar, the quartz content averages between 25 -35 percent and the mica content averages between 1-3 percent and seldom exceeds 5 percent. Minor hornblende is locally present. Accessory magnetite is usually present in meta-arenites in amounts less than 0.5 percent. However, on west-central Catchacoma Lake, in Cavendish Township it locally concentrated in amounts up to 1 percent within discontinuous quartz-rich lamallae in a thinly interbedded sequences of feldspthic meta-arenite and minor quartzose meta-arenite. These meta-arenites generally form thin-to medium bedded units and have a pronounced stratiform foliation. Minor interbeds of metawacke and metamudstone (biotite gneiss and schist) are common and relict features, such as graded bedding and cross-laminations are locally present.

Coarser-grained, migmatitic varieties of unit 4a contain less than 10 percent granitoid leucosome layers. These migmatitic rocks are locally abundant, in the northern part of the map-area: (1) between Loon Call Lake and Gold Lake along the northwestern flank of the Burleigh Dome; (2) to the north of Long Lake in the northeastern part of this dome; and 3) along the eastern flank of the Burleigh Dome between Big Cedar Lake and Long Lake in western Burleigh Township. Medium-to coarse-grained, migmatitic and non-migmatitic meta-arenites of the Hermon Group are very similar to the meta-arenites of the Anstruther Lake Group and their distinction from the rocks of this group is not always possible. In general meta-arenites of the Hermon Group are finer grained, thinner bedded and have better preserved small scale bedding features than meta-arenites of the Anstruther Lake Group. The Hermon meta-arenites characteristically contain much less (1-5 percent) biotite, in places muscovite and much less magnetite (0.5-1 percent) than the older meta-arenites; muscovite is rare or absent in the meta-arenites of the Anstruther Lake Group.

In the southwestern part of the map-area, near Big Bald Lake, feldspathic meta-arenite (unit 4a) generally occurs as thin interlayers in the metawackes, which are too thin to be shown on the map (back pocket). However, to the east the Burleigh Dome, near Cedar Lake in Burleigh Township, a medium grained, foliated pink feldspathic meta-arenites of map unit 4a do form narrow mappable units near the base of the Hermon Group along the eastern flank of the dome.

Farther to the east of the Burleigh Dome in the southeastern part of the map area, a distinctly different sequence of feldspathic meta-arenites containing subordinate interlayeres of metaconglomerate (map unit 4b) occurs near the base of the Hermon Group along the south shore of Stoney Lake in Dummer Township. This "basal" meta-arenite unit is thinly bedded, and consist mainly of massive, fine-grained, green to brownish-green feldspathic meta-arenite with subordinate massive, fine- to medium-grained, pinkish-grey to light grey feldspathic meta-arenite interbeds (Photo 5). Graded bedding, cross-laminations and scour-and fill-features can be observed, at several places along the shoreline in South and Puffer Bays at the east end of Stoney Lake. Between Gilchrist Bay and Dummer

Lake, near the south central shore of Stoney Lake, this same meta-arenite sequence contains subordinate metawacke interbeds and several interstratified, 0.5 - 4 m thick,green-to greenish-grey matrix-supported, polymictic pebble metaconglomerate horizons. Feldspathic meta-arenite forms the matrix of most of these conglomeratic units and subrounded to rounded pebbles, 0.5 cm to 4 cm in size compose from 20 to 60 percent of the rock. In order of decreasing abundance the pebbles are feldspathic meta-arenite, metawacke, metaquartz-arenite and para-amphibolite, in places biotite-hornblende-quartz-plagioclase gneiss. In some conglomeratic interbeds, mafic clasts predominate and the matrix is a weakly foliated biotite-hornblende-quartz plagioclase gneiss.

Near Gilchrist Bay, this meta-arenite-metaconglomerate sequence is coarsely recrystallized. The recrystallization was caused by a nearby syntectonic granite (map-unit 20), that in places contains partially, assimilated inclusions of the meta-arenites and metaconglomerates. At the east end of Stoney Lake near South Bay, this sequence has a composite thickness estimated to be 350-400 m and is stratigraphically overlain and separated from the younger Stoney Lake metavolcanics (see Table 4) by a narrow, less than 40 m thick, marble unit. Contacts between this "basal" clastic sequence with the overlying marble unit to the east and south are not exposed. Contacts between the clastic sequence and the overlying metavolcanics exposed on the islands to the north in Stony Lake are also not exposed. This "basal" meta-arenite-metaconglomerate sequence of the Hermon Group is informally termed, by the author the Dummer formation (see Table 4).

At the western end of Stoney Lake near Burleigh Falls, the the Dummer formation is absent, and here the lower part of the Hermon Group consists of an intercalated sequence of aluminous metapelite, metawacke, rusty weathering meta-arenite, para-amphibolite, marble and minor metaquartzarenite.

BIOTITE-RICH METASEDIMENTS

Biotite-rich metasediments of the Hermon Group (unit 5), which were derived from wackes and mudstones are the most abundant rocks in the lower part of the group in the northern part of the area. Here they occur: (1) along the northern flank of the Burleigh Dome, in southeast Cavendish and southern Anstruther Townships; and (2) northwest of the Volturno Lake granodioritic pluton in southeast Galway and northwest Harvey Townships. However, in the southeastern and southwestern parts of the map area, metawackes and metamudstones are much less abundant, and occur mainly as minor intercalated units in the feldspathic meta-arenites near the base of the Hermon Group.

Metawackes in this group are mainly fine to medium grained, foliated to layered, light grey to dark grey biotite-quartz-feldspar gneisses. They are heteroblastic and are composed predominantly of feldspar and quartz with 10-35 percent biotite and usually less than 5 percent hornblende. Plagioclase predominates over potassic feldspar. Hornblende and garnet commonly occur as porphyroblasts.

Compositional varieties in order of decreasing abundance include: (1) biotite-quartz-potassic feldspar-plagioclase gneiss (metawacke); (2) hornblende-biotite or biotite-hornblende-quartz-plagioclase gneiss (calcareous metawacke-metamudstone); and (3) minor thinly-laminated units of biotite schist (metamudstone) containing more than 50 percent biotite. Aluminous metamudstones (unit 7) are described under a separate heading in this report. With increasing hornblende and decreasing quartz and feldspar content, calcareous metawacke units may grade along or across strike into para-amphibolite (unit 6). Metawacke and/or calcareous metawacke generally form thin to medium layered units, which commonly contain minor interlayers of feldspathic meta-arenite, locally para-amphibolite. Relict thin bedding is commonly preserved, and the rocks have a pronounced stratiform foliation.

Narrow discontinuous lenses of matrix-supported pebble metaconglomerate occur locally in the metawacke in the following areas: (1) south of Big Bald Lake, Harvey Township in the basal epiclastic unit of the Hermon Group; and (2) along the northeast shore of Loon Call Lake, Anstruther Township. Metawacke forms the matrix of the conglomerate at both localities. Clasts are subrounded to rounded, range up to 2 cm in size and consist of variably coloured greenish-grey to dark grey metawacke.

Migmatitic varieties of metawacke (unit 5) containing less than 10 percent granitoid leucosome layers are locally abundant along the north-central boundary of the map area. These migmatitic rocks are concentrated near or adjacent to metamorphosed granite dikes and small plutons (unit 19) cutting the Hermon Group strata between Gold and Anstruther Lakes. In the southern part of the area, tightly folded, migmatitic northwest shore of Stoney Lake just to the east of Burleigh Falls. Here between Bravenders Bay and Horseshoe Island, dark grey, layered, migmatitic metawacke locally grades into nebulitic migmatite and/or massive-looking, light to medium grey granodioritic diatexite.

AMPHIBOLE-RICH METASEDIMENTS

Amphibole-rich metasediments of the Hermon Group (unit 6), derived mainly from calcareous mudstones and limy shales are concentrated along the northern flanks of the Burleigh Dome, near the north-central boundary of the area. These rocks are the third most abundant epiclastic metasediment in this region after metawacke and meta-arenite. In the northern part of the area, i.e. southern Cavendish and Anstruther Townships as well as the immediately adjacent parts of northeast Harvey and northwest Burleigh Townships, these rocks form numerous mappable, thin- to medium-bedded, locally laminated units in the lower to middle epiclastic metasedimentary sequences of the Hermon Group. Minor thin intercalated units, too small to show at map scale occur in the thick marble units of the Hermon Group in Cavendish and Anstruther Townships. In the southern part of the map area, amphibole-rich metasediments from minor units interstratified with: (1) the marble near the base of the Hermon Group exposed on Big Bald Lake in Harvey Township; and (2) aluminous metamudstone, metawacke and minor marble that form the basal sequence of the Hermon Group at the west end of Stoney Lake near Burleigh Falls.

Hermon Group, amphibole-rich metasediments are predominantly medium to coarse grained, foliated, layered, dark greenish-grey to black amphibolite and biotite amphibolite containing 5 - 10 percent biotite. Lighter grey units of hornblende-plagioclase gneiss and massive to layered units of dark green to greenish-grey calc silicate gneiss occur locally.

ALUMINOUS METAMUDSTONES

Schistose and foliated aluminous metamudstones of the Hermon Group (unit 7) consist of sillimanite-bearing biotite schist, sillimanite-quartz-feldspar gneiss, and garnet-rich biotite-and muscovite-biotite schists. These rocks, which are not very common are generally restricted to the Hermon Group and in, places serve as stratigraphic marker horizons. Sillimanite-bearing rocks form mappable units in the lower epiclastic sequence of the group in the southern part of the map area. Locally they form minor interflow units in the overlying metavolcanic sequences. Garnet-rich biotite and muscovite-biotite schists occur mainly as minor interflow units in the metavolcanics.

In the southcentral part of the area, at the west end of Stoney Lake near Burleigh Falls, sillimanite-bearing rocks are the second most abundant lithology after para-amphibolite in a 50-100 m thick epiclastic sequence near the base of the Hermon Group. In this sequence, green to greenish-grey garnet sillimanite-biotite-quartz-feldspar gneiss and locally sillimanite-biotite schist form thinly layered units, up to 20 m thick in the more abundant foliated, layered amphibolite. Intercalated with the thin-to medium-layered amphibolites are minor units of metawacke, garnetiferous metawacke, marble, rusty weathering schistose meta-arenite and locally rare metaquartzarenite.

This lower Hermon Group epiclastic sequence is exposed at numerous localities along the north shore and islands at the west end of Stoney Lake. On the east shore of Horseshoe Island, sillimanite gneiss is overlain by a narrow marble-amphibolite unit which separates it from the stratigraphically higher metavolcanics. On the south shore of this same island, however, the sillimanite gneiss is intercalated with and overlain by the metavolcanics. Approximately 250 m south of this island, on the south shore of Stoney Lake, migmatitic meta-arenites of the Anstruther Lake Group are exposed. They have the same structural trend as the Hermon Group strata to the north on Horseshoe Island, however, the contact between the two groups is not exposed. Along strike to the west of Horseshoe Island, the same sillimanite gneiss unit, described above is exposed along the northwest shore of Stoney Lake and some of the islands in Bravender Bay. Along the north shore of Woods and Fraser islands in this bay, sillimanite gneiss and localy schist conformably overlies a basal unit of rusty weathering, iron-rich feldspathic meta-arenite. The upper part of this para-amphibolite-sillimanite gneiss and schist sequence is also exposed in several small roadcuts along Highway 28, to the east of Burleigh Falls. At Fraser's secondary access road, just to the north of the small creek that flows southeasterly into Bravenders Bay, the upper contact of this sequence is exposed. Here, a 3-5 m thick, thinly layered unit of garnet sillimanite-biotite-quartz-feldspar gneiss is intercalated with and conformably overlain by gneissic and layered mafic metavolcanics. Underlying and locally intercalated with the sillimanite gneiss is a sequence of foliated to layered para-amphibolite containing minor thin interlayered bands of metawacke and marble. Thinly interlayered with one of the marble bands are several 2 cm thick interbands of metaquartzarenite. The contact with the Anstruther Lake Group migmatitic meta-arenites which outcrop to the west along Highway 28 is not exposed and is interpreted to be a fault (in map, back pocket).

To the east of Burleigh Falls, along the central and at the eastern end of Stoney Lake, sillimanite-bearing rocks are rare or absent in the lower epiclastic sequence of the Hermon Group. Here the lower sequence is predominantly feldspathic meta-arenite and subordinate metaconglomerate (unit 4b), and is here in informally termed the Dummer formation.

In the western part of the map area, sillimanite gneiss occurs in the lower epiclastic sequence, along the southwestern flank of the Burleigh Dome in Harvey Township. Here, thin to medium layered garnetiferous sillimanite gneiss and locally schist form a 90 to 125 m thick, north-trending unit between Sandy and Big Bald Lakes. Minor units of metawacke and marble occur locally within these gneisses. Conformably overlying this lower epiclastic unit on the west is a 150 - 200 m thick sequence of marble and minor para-amphibolite.

Further to the west this sequence is itself overlain by a thick accumulation of mafic metavolcanics. To the east, the sillimanite gneisses are conformably underlain by a thin basal unit of metawacke containing minor interbeds of metaconglomerate up to 0.5 m thick. The contact between this basal sequence of the Hermon Group and the older feldspathic meta-arenites of the Anstruther Lake Group was not observed. Here, the two groups are exposed less than 30 m apart, and their structural trends are conformable. In contrast to the previously described contact relation between these groups on Stoney Lake, the underlying Anstruther Lake Group feldspathic meta-arenites are not migmatitic and, where primary bedding is preserved, grain size gradations in the Anstruther Lake Group meta-arenites indicate tops to the west.

In the metavolcanics to the north and west of Big Bald Lake, sillimanite-bearing rocks also occur locally as minor interflow units, most of which are two small to show on the map (back pocket). However, mappable interflow units of pyrite-bearing, biotite and muscovite-biotite schist and gneiss are locally abundant in the intermediate to felsic metavolcanics north of Pigeon and Little Bald Lakes. Further north in southwestern Cavendish Township, narrow mappable interbeds of garnetiferous and muscovitic biotite schist and gneiss form prominent marker horizons in the metavolcanics. Two of the largest units, lying to the southwest of Squaw Creek appear to separate a lower unit of predominantly mafic to intermediate flows from an upper unit of predominantly intermediate to felsic pyroclastic rocks.

EPICLASTIC AND CHEMICAL METASEDIMENTARY ROCKS

IRON-RICH METASEDIMENTS

Iron-rich metasediments (unit 8) are composed of the following major lithologies: (1) rusty weathering feldspathic meta-arenites; (2) foliated, in places layered rusty weathering quartzo-feldspathic schist and gneiss; (3) muscovite-quartz-pyrite schist; (4) rusty weathering pyritic feldspar-quartz-biotite schist; and 5) magnetite ironstone. Many of these rocks occur together or grade into one another along strike and have been mapped as single units. They are spatially associated with the metavolcanics.

At the west end of Stoney Lake, in Burleigh Township, rusty weathering feldspathic meta-arenites to locally quartzo-feldspathic schist form a 20-100 m thick sequence near the base of the Hermon Group. Along the north shore of Woods and Frasers Islands in Bravenders Bay on this lake, these rusty meta-arenites are intercalated with and conformably overlain by sillimanite gneisses. To the north of these islands along the north shore of the lake both lithologies are conformably overlain by metavolcanics. To the east of Frasers Island this rusty weathering meta-arenite unit thins out and becomes intercalated with mafic flows and locally sillimanite schist. The trend of this south-dipping unit, on the lake parallels the trend of the Anstruther Lake Group migmatitic meta-arenites exposed to the south along the southwest shore of Stoney Lake. The contact between these rusty meta-arenites and the rocks of the Anstruther Lake Group is not exposed.

At the eastern end of Stoney Lake, between Quarry and Hull Bays a mappable unit of thinly interbedded feldspathic meta-arenite, metawacke, rusty weathering meta-arenite and locally minor units of lean magnetite ironstone occurs as an interflow unit in the mafic metavolcanic flows. Along strike to the northeast towards Nephton on an east-west access road, exposures of this same unit consist of rusty weathering quartzofeldspathic schist and muscovite-quartz-pyrite schist containing disseminated to locally minor massive pyrite. Further to the northeast near Nephton, this same horizon in the metavolcanics consists of thin to medium bedded, rusty weathering feldspathic meta-arenite.

In southeastern Galway Township and south of Mississagau Lake in northern Harvey Township, rusty weathering quartzofeldspathic schist and gneiss form a mappable interflow unit in the mafic metavolcanics. Between Pigeon Lake and Highway 36 in Harvey Township, muscovite-quartz-pyrite schist and pyritic feldspar-quartz-biotite schist form one narrow mappable unit and numerous minor thinly interlayered units in the intermediate to felsic pyroclastic rocks. These units are not shown on the map (back pocket).

CHEMICAL METASEDIMENTARY ROCKS

CARBONATE METASEDIMENTS

Siliceous calcitic and locally dolomitic marble (unit 9) form major units in the middle to upper part of the Hermon Group in the western and northern part of the map-area, but only minor units in the lower sequence of epiclastic rocks in the eastern part of the area. Here marble is concentrated near the top of the lower epiclastic metasedimentary sequence and is commonly intercalated with and conformably overlain by metavolcanics.

Hermon Group marble is petrographically indistinguishable from marble of the younger Mayo Group. In general, however, Hermon Group marbles tend to be coarser grained and contain more silicate mineral impurities than the Mayo Group marbles and have lost most small scale bedding features due to recrystallization. Subordinate interbeds of para-amphibolite and calc-silicate gneiss are volumetricaly more abundant in marble units of the Hermon Group than in the marble sequences of the Mayo Group.

The Hermon Group marbles tend to be thin to medium bedded. The bedding is defined by colour layering, variation of the content of silicate minerals, and by locally abundant, thin interbeds of para-amphibolite, calcsilicate gneiss, and in places, feldspathic meta-arenite, metawacke, and very minor metaquartz-arenite and/or recrystallized chert. The marble is granoblastic, varies in colour from white to light grey and locally buff-brown, and contains in excess of 70 percent crystalline calcite or dolomitic calcite. Variable amounts of phlogopite, diopside, tremolite-actinolite, biotite, graphite and chondrodite make up the remainder of the rocks. Other silicates such as quartz, feldspar, hornblende and scapolite may be present in amounts up to a few percent. Accessories are pyrite and magnetite.

The most common varieties of Hermon Group marble present in the map-area are phlogopite marble and phlogopite-diopside marble. Both these varieties are generally calcitic. Tremolite-actinolite dolomitic marble is common: (1) along the west side of Catchacoma Lake in Cavendish Township, as well as in the same stratigraphic horizon that underlies the Picard Lake anticline (Bright, 1980) to the west of this lake; and (2) at De Gaulle Lake in southern Galway Township. Interbeds of buff-brown coloured, silicate mineral-poor dolomitic marble occurs on De Gaulle Lake as well as in the larger interflow marble unit in the metavolcanics to the west of Mississagua Lake in southern Cavendish Township.

In the northern part of the map area, most of the marble occurs at the same stratigraphic level as the rocks just described in the synform between the Burleigh Dome and the adjacent Anstruther Dome to the north (Nos. 1 and 2 respectively, Fig. 7). On Catchacoma Lake in southern Cavendish Township, this unit of marble contains minor intercalated amphibolite and metawacke and has an estimated thickness of 400 - 450 m. The same marble unit is exposed to the west of Catchacoma Lake in the core of the Picaud Lake anticline. In Anstruther Township east of Catchacoma Lake, a fault bounded, easterly trending segment of this unit is exposed on Anstruther Lake where it has an estimated thickness of about 180 m. In the northern part of the map area, along the southern flanks of the Anstruther Dome this marble unit overlies the lower metawacke-amphibolite sequence of the Hermon Group. To the north of the map area, in the adjacent Eels Lake area these units occupy the same stratigraphic position along the flanks of the Anstruther and Cheddar Domes and were described as the Monmouth formation (see Table 4) (Bright 1977, 1980).

Along the southern limb of the synform between the domes, i.e., the northwestern flank of the Burleigh Dome, marble units are rare and those minor units present are probably not equivalent to the Monmouth formation.

In the southwestern part of the map, the marble-amphibolite sequence between Sandy and Big Bald Lakes is interpreted by the author as a possible equivalent of the Monmouth formation. This 150 - 250 m thick marble-rich sequence is intercalated with and conformably overlain by mafic metavolcanics. Here some of the interflow units of marble, in and near the metavolcanics locally contain disseminated pyrite-minor sphalerite and galena mineralization (Morton, 1983).

METAVOLCANIC ROCKS

INTRODUCTION

In the map-area mafic to felsic metavolcanics of the middle to upper Hermon Group (units 10 and 11) occur at several places along the flanks and to the east and west of the Burleigh Dome. The metavolcanic succession is thicker along the western flank of this dome than the east flank. In general, metavolcanics conformably overlie and are locally intercalated with the epiclastic and chemical metasediments of the lower Hermon Group. In turn these metavolcanics are conformably overlain by carbonate and locally epiclastic metasediments of the Mayo Group.

For mapping purposes, the metavolcanics were subdivided into: (1) mafic to intermediate metavolcanics (unit 10) containing more than 35 percent mafic minerals; and (2) intermediate to felsic metavolcanics (unit 11) containing less than 35 percent mafic minerals. Within this second group, the more felsic units generally contain less than 15 percent mafic minerals. These rocks were metamorphosed under almandine-amphibolite facies rank conditions.

Mafic to intermediate metavolcanics are medium (1 mm to 5 mm) to coarse grained (greater than 5 mm) and vary from dark green to black. Medium grey mafic varieties to medium and lighter grey intermediate rocks also occur. Textures vary from massive to foliated and, in places layered. Primary igneous textures that are locally preserved include pillows, flow-top breccias, flow-banding, phenocrysts and amygdules. The fairly continuous and sharply bounded layering in the grey intermediate metavolcanic units, are interpreted by the author as primary tuffaceous bedding or flow-banding.

Intermediate to felsic metavolcanics are medium to light grey, pinkish grey to pink and locally white to very light grey. Flows are fine to medium grained and vary from weakly foliated to foliated and locally layered gneissic units (Photo 6). Flow-top breccias and flow-banding occur locally. Intermediate to felsic pyroclastic rocks are medium to locally coarse grained, foliated to layered tuff, lapilli-tuff and lapilli- stone. These rocks are commonly interlayered in thin to medium bedded (3 - 30 cm) sequences (Photos 6, 8 - 10). Tuff also forms extremely thickly bedded (greater than 3 m) units:(1) in the eastern part of the map-area, at the east end of Stoney Lake and along Highway 28 north of Burleigh Falls; and (2) in the western part of the area along the north shore of Pigeon Lake in Harvey Township and in the southwestern part of Cavendish Township. Intermediate to felsic tuff-breccia units (Photo 7) in which the elongated clasts average more than 10 cmin diameter and, in places range up to 30 cm, were observed in several places in the southwestern part of Cavendish Township.

In the western part of the area to the northwest and west of the Burleigh Dome, the metavolcanic succession was termed the Cavendish-Harvey metavolcanics (Bright 1980). In the eastern part of the map-area, the metavolcanics along the eastern flank and further to the east of this dome have been subdivided into: (1) the Stoney Lake metavolcanics occurring along Stoney Lake to the southeast of the Burleigh Dome and (2) the Loon Call Lake metavolcanics occurring along the northern and eastern flank of this dome.

Major petrographical and chemical characteristics of these three metavolcanic successions are described in the following subsections.

CAVENDISH-HARVEY METAVOLCANICS

In the western part of the map area this deformed mafic to felsic metavolcanic succession trends north-northeasterly along the western flanks of the Burleigh and adjacent Anstruther Domes for a strike length of about 22 km; it continues for an additional 14 km to the north in the adjacent Eels Lake area (Bright 1980). In the map area, these metavolcanics have a maximum exposed width of about 5 km in southwestern Cavendish Township.

The Cavendish-Harvey metavolcanic succession consists of:

1. A lower sequence of predominantly mafic to intermediate massive and locally pillowed flows with minor interflow units of intermediate to felsic tuff, ferruginous epiclastic metasediments and locally near the base of the succession minor intercalated carbonate and clastic metasediments.
2. An upper sequence of predominantly intermediate to felsic tuffs, lapilli-tuffs and locally volcanic breccias with subordinate intercalated units of mafic to intermediate flows and tuffs. Minor intercalated units of schistose, aluminous and ferruginous metamudstone are locally present.

In southwestern Cavendish Township the composite thickness of this volcanic succession is estimated by the author to be 1,100 - 1,400 m. To the south in Harvey Township, the succession between Little Bald and Pigeon Lake is estimated to be 950 - 1,100 m thick.

Whole rock, major-element analyses for 30 specimens are given in Table 2. On Figure 3, the Jensen (1976) Cation Diagram, and Figure 4, the Irvine and Baragar (1971) AFM Diagram, the analyses are classified as a predominantly tholeiitic mafic to felsic volcanic suite. The few calc-alkaline mafic to intermediate units indicated on these plots occur in the upper intermediate to felsic sequence of the succession.

A more detailed petrographic description and subdivision of the intermediate to felsic metavolcanics in Harvey Township is given by Morton (1983).

STONEY LAKE METAVOLCANICS

The Stoney Lake metavolcanic succession forms a 32 km long and 200-1,300 m wide, U-shaped band of tightly folded mafic to felsic metavolcanic in southern Burleigh and southwestern Methuen Townships. It structurally and stratigraphically underlies a thick sequence of marbles of the Mayo Group exposed to the north in the refolded Chandos Lake synclinorium between the Burleigh Dome to the west and the northeasterly trending Methuen granitic pluton to the east along the eastern boundary of the map area.

To the east of this synclinorium, along the eastern boundary of the map-area, the metavolcanic succession is deformed about the Methuen pluton and the adjacent Horse Lake gabbro sill. To the east of the map area in southern Methuen Township, a thick sequence of predominantly intermediate to felsic metavolcanics was termed the Oak Lake Series by Hewitt (1961) and later the Oak Lake Formation by Lumbers (1967a, b).

The intermediate to felsic and mafic metavolcanic succession in the central part of Stoney Lake and at the eastern end of this lake is in part correlated by the author with the Oak Lake Formation. Here the succession has a maximum composite thickness of about 650 m and consists of the following subdivisions of undetermined thickness:

1. A lower, subordinate sequence of mafic to intermediate, massive flows and minor tuffs. Intercalated with these rocks in the upper part of this lower sequence, along the northeast shore of Stoney Lake are minor units of intermediate to felsic tuffs, ferruginous and pyrite-bearing

meta-arenites, para-amphibolite and marble. This lower sequence is commonly absent along the south shore, in the central and at the eastern end of Stoney Lake.

2. A thicker, upper sequence of intermediate to felsic tuffs and lapilli-tuffs that possibly correlates with the Oak Lake Formation. Intercalated minor units of mafic to intermediate flows and tuffs are locally abundant in the lower part of this upper sequence.

At the western end of Stoney Lake near Burleigh Falls, as well as to the north of Burleigh Falls at Big Cedar Lake, the Stoney Lake metavolcanic succession is more strongly folded than to the east. In many places it is offset by numerous regional faults. It is a much thinner succession than that exposed to the east on Stoney Lake. It is 360-450 m wide and consists of the following subdivisions of undetermined thickness:

1. A lower sequences of predominantly mafic flows with subordinate, intercalated units of mafic to intermediate tuffaceous rocks. Minor intercalated units of clastic and carbonate metasediments are locally present.
2. A thinner upper sequence of intermediate to felsic tuffs and minor flows.

To the north of Big Cedar Lake the western succession of the Stoney Lake metavolcanics, along the southeastern flank of the Burleigh Dome is offset by several easterly trending thrust faults.

Loon Call Lake Metavolcanics

The Loon Call Lake metavolcanic succession forms a 250-750 m wide band of tightly folded, mafic to felsic metavolcanics around the northeastern end of the Burleigh Dome. It appears, in part to be the on strike northern extension of the Stoney Lake metavolcanic succession exposed to the south at Cedar Lake. At the eastern end of Loon Call Lake the metavolcanic succession has a maximum composite thickness of about 400 m and consists of the following subdivisions of undetermined thickness:

1. A subordinate lower sequence of intermediate to felsic tuffs containing minor intercalated clastic metasediments and mafic to intermediate metavolcanics.
2. An upper sequence of predominantly massive mafic flows.

The lower sequence is correlated by the author with the upper sequence of the previously described western Cedar Lake succession of the Stony Lake metavolcanics. The upper mafic flow sequence, is correlated with a sequence of tholeiitic basaltic flows that occur to the north of the map area in the adjacent Eels Lake area (Bright 1980, in press).

Whole-rock, major-element analyses obtained from the Stoney Lake and Loon Call Lake metavolcanics are given in Table 3. On Figure 5, the Jensen (1976) Cation Diagram, and Figure 6, the Irvine and Baragar (1971) AFM Diagram these analyses project as follows:

1. A predominantly calc-alkaline mafic to felsic metavolcanic suite in the eastern (Stoney Lake) succession of the Stoney Lake metavolcanics.
2. A predominantly tholeiitic mafic to felsic metavolcanic

suite in the western (Cedar Lake) succession of the Stoney Lake metavolcanics and in the lower sequence of the Loon Call Lake metavolcanics. The upper part of the succession near Loon Call Lake belongs to a separate tholeiitic suite of basaltic flows to the north of the map-area which the author named the Eels Lake metavolcanics (Bright, in press).

MAYO GROUP

INTRODUCTION

The Mayo Group consists predominantly of marbles with subordinate clastic metasediments. The rocks of this group are distributed along the eastern and western margins of the Harvey-Cardiff Basement Arch. Along the eastern margin of this arch in the eastern part of the area, Mayo Group strata occur along and to the east of the fault-bounded eastern flank of the Burleigh Dome. In eastern Burleigh, southern Anstruther, southern Chandos and northwestern Methuen Townships, the Mayo Group underlies the southern end of the cross-folded, Chandos synclinorium.

In the northwestern corner of the map area, in southeastern Galway Township, strata of the Mayo Group occur along the extreme western margin of the Harvey-Cardiff Basement Arch. Here marbles and minor metawackes from the lower part of a thick sequence of Mayo Group strata that occurs to the west of the map-area.

The Mayo Group has been subdivided into the following two lithological subunits:

1. A lower chemical-epiclastic metasedimentary sequence which has been correlated by the author with the marble-rich Dungannon Formation, first described near Bancroft, by

Hewitt and James (1956).

2. An upper epiclastic metasedimentary sequence, near the village of Apsley in the northeast corner of the map area, that was termed the Apsley Formation by Shaw (1962).

The Dungannon Formation conformably overlies the Hermon Group metavolcanics throughout the map area. In the northeastern part of the map area, where the Apsley Formation forms the upper part of the group, the composite thickness of the Mayo Group, i.e., Dungannon Formation plus Apsley Formation is estimated to be 1,500 - 1,700 m, the Dugannon Formation making up 650-700 m. To the south near Stoney Lake where the Apsley Formation is absent, the Dungannon Formation is estimated to be 900 - 1,100 m thick.

CHEMICAL AND EPICLASTIC METASEDIMENTARY ROCKS

DUNGANNON FORMATION

SILICEOUS CLASTIC METASEDIMENTS

In the map area, siliceous clastic metasediments (unit 12) comprise less than 5 percent of the Dungannon Formation. These rocks consist mainly of feldspathic meta-arenite with subordinate units of metawacke and calcareous metawacke. Minor units, present locally include rusty weathering quartzofeldspathic gneiss and schist, pyrite-quartz-feldspar gneiss, biotite schist and calcite-biotite schist derived from mudstones.

These metamudstones generally occur as thin interbeds in the marbles. Most of these interbeds are too small to be shown on the map (back pocket). The more abundant feldspathic meta-arenite however, does locally form narrow, mappable units at the base of the Dungannon Formation in the southeastern part of the map area. At Quarry Bay on the northeastern shore of Stoney Lake, the basal clastic sequence of the formation consists predominantly of fine- to medium-grained, pink to pinkish grey, feldspathic meta-arenite. Thinly interbedded with these meta-arenites, in places are interbeds of gneissic, medium-grained, grey to dark grey metawacke. In the contact metamorphic aureole of the Quarry Bay stock, metawacke interbeds are coarse grained, gneissic, in places layered and commonly contain porphyroblasts of garnet and biotite.

AMPHIBOLE-RICH METASEDIMENTS

Amphibole-rich metasediments (unit 13) consisting mainly of para-amphibolite and hornblende-plagioclase gneiss with subordinate gradational phases of calcsilicate gneiss that were derived from calcareous mudstones and limey shales. These rocks comprise between 10 - 15 percent of the Dungannon Formation in the map area.

In the eastern part of the map area, mappable units of these rocks occur mainly near the base and at the top of the Dungannon Formation. Minor, thin units of these rocks, too small to be shown on the map (back pocket), are interlayered with the marble thoughout eastern Burleigh and northwestern Methuen Township. In the northwestern part of the map-area, interbeds of these rocks are much less abundant in the Dungannon Formation.

Para-amphibolites are fine to medium grained, dark green to black, and foliated, in places thinly layered. They consist mainly of variable amounts of hornblende and plagioclase with minor biotite and accessory quartz, garnet and potassic feldspar. The subparallel alignment of hornblende and biotite imparts a strong foliation to these rocks. Hornblende-plagioclase gneiss is medium to coarse grained, and grey to dark greenish-grey. It consists mainly of plagioclase and subequal amounts of hornblende with up to 10 percent biotite. Hornblende commonly forms porphyroblasts or porphyroclasts. Biotite is common in medium grained, foliated varieties. In coarser, banded varieties, porphyroblastic hornblende and biotite-rich lamallae or thin layers alternate with discontinuous finer-grained granoblastic layers of hornblende and biotite-hornblende-poor plagioclase gneiss.

Interbeds of amphibolite and hornblende-plagioclase gneiss in the marble may be interlayered with or grade along strike into units of calcsilicate gneiss. This rock is medium to coarse grained, greenish-grey to dark green, massive to layered and contains variable amounts of equigranular to subequigranular pyroxene, hornblende and plagioclase as the main constituents. Minor constituents are biotite, quartz, potassic feldspar, phlogopite, garnet and epidote. Calcite is usually present in amounts up to 10 percent. With increasing calcite content, these interbeds grade into siliceous marble.

CARBONATE METASEDIMENTS

Siliceous calcitic to locally dolomitic marble (unit 14), derived from impure limestone and dolostone comprise about 80 percent of the Dungannon Formation in the eastern part of the area. Here, the formation has an estimated composite thickness of 650 - 700 m. North of Jack Lake, in the northeast corner of the area, the Dungannon Formation is conformably overlain by and locally infolded with younger, epiclastic metasediments of the Apsley Formation. In the northwest corner of the map area to the south of Crystal Lake, marble comprises more than 90 percent of the Dungannon Formation.

These marbles are generally medium to coarse grained, granoblastic and vary in colour from white to pale grey or bluff. They generally contain in excess of 70 percent carbonate (usually calcite) with variable amounts of phlogopite, diopside, biotite, tremolite-actinolite, graphite and chondrodite. Other minerals locally present in amounts up to a few percent are hornblende, quartz, plagioclase and scapolite. Accessories are magnetite and pyrite. The most common marble varieties are phlogopite marble, diopside-phlogopite marble and diopside marble.

A relict, thin bedding or lamination is preserved in many of the marble exposures in the upper part of the Dungannon Formation, along Highway 28 north of Julian Lake and along the secondary access road around Young Bay on Stoney Lake (Photo 13). Primary sedimentary features, besides common bedding that occur locally are graded beds, scour-filled troughs and soft-sedimentary deformation features.

North of Eels Creek on Highway 28 in central Burleigh Township, the marbles in the lower part of the Dungannon Formation tend to be thin to medium bedded, coarsely recrystallized and contain more than 10 percent silicate minerals. A relic primary layering is defined by alternating layers that vary in colour, grain size and silicate mineral content. Thinly interbedded, minor units of para-amphibolite and calcsilicate gneiss (Photo 14) are common in this section.

Cataclastic marble and marble tectonic breccia (Photo 15) are locally abundant near, and adjacent to, major zones of shearing and faulting. Several good exposures occur to the east of Long Lake, along Highway 28 and nearby along Eels Creek in the northeastern part of the map-area.

EPICLASTIC METASEDIMENTARY ROCKS

APSLEY FORMATION

Siliceous Clastic Metasediments

In the northeast corner of the map area, the Apsley Formation appears to conformably overlie amphibole-rich metasediments at the stratigraphic top of the Dungannon Formation. The Apsley Formation which is possibly of turbidite origin, consists of a 600 - 700 m thick sequence of thinly interbedded metawacke and subordinate feldspathic meta-arenite. Shaw (1972) has suggested that this well bedded sequence may, in large part be composed of distal intermediate to felsic tuffs and reworked tuffs. On fresh surfaces the metawacke is fine grained (grain size less than 1 mm), massive to weakly foliated and medium grey to black. The feldspathic meta-arenite is slightly coarser grained (grain size up to 2 mm), massive to weakly foliated and pinkish-grey to light grey in colour. In many places the meta-arenites contain up to one percent, finely disseminated pyrite and have rusty brown weathered surfaces. A thin or rusty brown gossan derived from these ferruginous meta-arenite interbeds commonly stains and masks the normally, adjacent metawacke interlayers. Detailed petrological and geochemical studies of the Apsley Formation in Chandos and Anstruther Townships are given by Simony (1960) and Shaw (1962, 1972).

The formation is well exposed along Highway 28 and the Jack Lake access road south of Apsley. Along Highway 28, individual beds, many less than 5 cm thick, maintain their thickness along strike for several tens of metres and commonly show numerous small scale slump features and graded bedding. Cross-bedding or cross-laminations were not observed. Just to the north of the map area, near the junction of Highway 28 and the north turnoff to Apsley, there are several minor intraformational monomictic matrix-supported conglomerate lenses in thin to medium bedded metawacke.

The thinly bedded character of this formation is maintained towards its basal contact with the underlying intercalated para-amphibolite and minor marble of the upper Dungannon Formation. Near the base of the Apsley Formation, metawacke units are coarser grained and biotite and hornblende porphyroblasts are locally abundant. The basal contact with the Dungannon Formation is exposed along Highway 28 near the northern boundary of the map area. It is a narrow transition zone, less than 5 m wide consisting of thin to medium interbedded metawacke and calcareous metawacke containing minor interlayers of para-amphibolite, marble and locally biotite schist. These calcareous lithologies are absent from the formation in other places.

STRATIGRAPHIC SUMMARY OF THE GRENVILLE SUPERGROUP

In the Burleigh Falls area, the combined thickness of the Anstruther Lake, Hermon and Mayo Groups is estimated to be 4,000 - 4,500 metres. Table 4 is a summary of the lithostratigraphic subdivisions of the Grenville Supergroup discussed in this report or in the report on the adjacent Eels Lake area previously studied by the author (Bright 1977, 1980, in press). In Table 4, the Burleigh Falls area has been divided into two subareas because regional correlation northwestward across the Harvey-Cardiff Basement Arch, the site of the Burleigh Dome, is only possible at the "group" level.

East of the Burleigh Dome, the map area forms part of the eastern margin of the Hastings Basin sub-region (Wynne-Edwards 1972). Lithostratigraphic correlation at the "formation" level with the Grenville Supergroup subdivisions to the east in the Bancroft-Madoc area (Lumbers 1967a and b, Moore and Thompson 1980) can be substantiated in the field. An example of this is: the upper intermediate to felsic pyroclastic sequence of the Stoney Lake metavolcanics is probably the strike extension of the Oak Lake Formation (Lumbers 1976b) in Methuen and Lake Townships to the east of the map-area.

METAMORPHOSED MAFIC INTRUSIVE ROCKS

Metamorphosed mafic intrusive rocks consisting mainly of metagabbro, and metadiorite (unit 16) form several homogeneous to locally compositionally layered sills from 100 m to 480 m thick. These sills, together with their related minor satellitic dikes, are concentrated in the Hermon and Mayo Group strata. They have been intruded and brecciated by both the early and late metamorphosed granitic plutons and are cross cut by numerous small late tectonic, unmetamorphosed pegmatitic granite sills and dikes. It would appear that these sills were emplaced prior to initial folding of the rocks of the Grenville Supergroup, since they exhibit the same two stages of deformation recognized in the enclosing Grenville Supergroup country rock.

Mafic sills and minor dikes of the map area are tentatively correlated with the large Tallan Lake metagabbro sill in eastern Anstruther and western Chandos Townships, just to the north of the map area. This sill represents the earliest recognized phase of plutonic activity in the adjacent Eels Lake area (Bright, 1980). A whole-rock Rb-Sr radiometric age of 1,228±22 Ma for its emplacement was interpreted by Heaman et al, (1980).

In the northwestern part of the map-area near Loom and Udra Lakes in Southeast Galway Township, the predominant rock types in two large mafic sills are medium to coarse grained, dark green to grey-green metagabbro, and lighter grey-green hornblende-plagioclase gneiss, possibly a metadioritic phase of the sills. Metagabbro predominates in the central region of these sills and consists mainly of hypidioblastic to granoblastic plagioclase and hornblende with minor biotite, magnetite, garnet and epidote. Textures vary from massive to weakly foliated and strongly foliated. Relic subophitic texture is locally preserved in some weakly foliated gabbroic varieties, as well as a primary compositional layering consisting of alternating thin continuous layers of massive to weakly foliated melanocratic and leucocratic metagabbro. Near the margins of these sills, foliated metagabbro generally grades into hornblende-plagioclase gneiss that is coarser grained than the metagabbro itself.

At the eastern margin of the map area, in southern Methuen Township is exposed the western part of an oval, mafic sill which Hewitt (1961) named the Horse Lake Intrusive. This 5.6 km long intrusion occupies the core of a basin-shaped structure between the Methuen granitic pluton to the north and a related, poorly exposed, unnamed granitic pluton to the south. According to Hewitt (1961) this massive to locally weakly foliated sill consists predominantly of diorite with local gradational phases of quartz diorite and noritic gabbro. The western end of this sill is predominantly medium-to coarse-grained, massive greenish-grey metadiorite. In thin section, this rock has a hypidiomorphic, granular texture and consists, in order of decreasing abundance, of plagioclase, hornblende and biotite with accessory opaque minerals, carbonate, apatite and chlorite. The plagioclase composition ranges from oligoclase to andesine (Hewitt, 1961).

Along its contacts with rocks of the Grenville Supergroup, the Horse Lake mafic sill was intruded by a crescent-shaped granitic dike; a satellite intrusion of the larger Methuen Pluton. Near the contact of the dike with the sill, massive to weakly foliated metadiorite grades into hornblende-plagioclase gneiss.

Northeast of the Methuen granitic pluton, near Jack Creek in western Methuen Township, a 100 m thick mafic sill occurs in the Hermon Group strata near its contact with the Mayo Group metasediments. The contacts of the sill and its internal fabric parallel that of the deformed country rock for a strike length of more than 6 km. This mafic rock is a fine-to medium-grained, dark grey foliated to lineated amphibolite consisting of granoblastic hornblende and plagioclase with minor quartz, garnet and biotite (Hewitt 1961). Other accessories present include titanite, apatite and opaque minerals. In the northeastern part of the sill, on lot 20, Concession VIII, Methuen Township, Hewitt (1961) reported an occurrence of metaperidotite, which under the microscope, consisted of "sheared and shattered olivine and pyroxene" with spinel, rutile, opaque minerals and secondary hornblende as accessories.

Both the author and Morton (1983) observed several narrow fine-grained amphibolite, in places medium-grained foliated metagabbro dikes and sills cutting the mafic metavolcanics and locally the felsic metavolcanics and metasediments near the base of the Hermon Group on Stoney Lake and Little and Big Bald Lakes.

METAMORPHOSED ALKALIC INTRUSIVE ROCKS

INTRODUCTIONS

Metamorphosed alkalic intrusive rocks have been subdivided, for mapping purposes, into two major lithological groups. In order of decreasing abundance this subdivision consists of: (1) an older suite of nepheline syenites (unit 17); and (2) a somewhat younger suite of potassic syenites (unit 18). Both suites form sills in the upper Hermon Group metavolcanics and metasediments, as well as in the immediately overlying carbonate metasediments of the lower Mayo Group. These intrusions which include the Blue Mountain Nepheline Syenite Complex are restricted to areas where metavolcanics abound, i.e., in the northwestern and southwestern parts of the map area.

These alkalic rocks are correlated with similar metamorphosed alkalic rocks which comprise the Haliburton-Bancroft Nepheline-Syenite Belt (Adams and Barlow 1910, Hewitt 1961), to the north of the map area in the Eels Lake area (Bright 1980). Miller (1979) has reported a U-Pb zircon radiometric age of 1,225±3 Ma for a nepheline syenite gneiss near Laronde Creek in the northern part of the Eels Lake area. Samples from the Blue Mountain Nepheline Syenite Complex (Hewitt 1961, Krogh and Hurley 1968), in the map area reported a whole-rock Rb-Sr radiometric age of 1,285±41 Ma which they interpret as its age of crystallization.

NEPHELINE SYENITE

BLUE MOUNTAIN NEPHELINE SYENITE COMPLEX

The Blue Mountain Nepheline Syenite Complex (unit 17) is located in southwestern Methuen and southeastern Burleigh Townships, along the eastern boundary of the map area. The southwestern arm of this nepheline syenite body forms a prominent topographic ridge, called Blue Mountain that rises up to 66 m above the surrounding countryside. The nepheline syenite is quarried by Indusmin Limited (property No. 10 on map in back pocket).

Hewitt (1961) and Payne (1968) present a comprehensive synthesis of the research on this alkalic complex since its earliest description by Miller (1898). The following summary is based upon both these earlier studies and the author's reconnaissance of the southwestern arm of the alkalic complex.

The Blue Mountain Nepheline Syenite complex is a folded, massive to foliated and/or lineated, compositionally layered sill that was emplaced into relatively flat-lying Hermon Group strata prior to the first major deformation event that affected the rocks of the Grenville Supergroup. Shortly after its emplacement, a younger alkalic suite of potassic syenite sills (unit 18) intruded and metasomatized parts of the older nepheline syenite as well as the adjacent Hermon Group strata. Following this, all these rocks were subjected to at least two major periods of deformation and accompanying granitic plutonism.

In the map area the nepheline syenite sill lies along the westerly-overturned, eastern limb of the southwesterly plunging Blue Mountain anticline. Along its strike, the sill varies in true width from less than 60 m southwest of Nephton to more than 500 m northeast of Nephton. The narrow, southwestern part of the sill near Nephton consists mainly of medium- to coarse-grained, foliated, white, muscovite-nepheline syenite. With increasing width to the northeast of Nephton, the sill develops a crude compositional zoning consisting of the following: (1) a lower zone of foliated, grey hornblende nepheline syenite adjacent to younger foliated pink potassic syenite; and (2) an upper zone of massive to foliated and locally lineated, greyish-white to grey muscovite and biotite-muscovite nepheline syenite. Locally in the upper part of the sill, coarse-grained phases of muscovite-magnetite nepheline syenite are present.

The sill contacts are generally sharp and conformable with the adjacent Hermon Group strata. However, in detail cross cutting relationships and gradational contacts with the Hermon Group metavolcanics and metasediments can be observed. The gradational contacts were caused by metasomatism.

On Stoney Lake to the southwest of Nephton, nepheline syenite occurs as narrow, discontinuous lenses (too small to show on the map in back pocket) within the younger pink potassic syenite gneiss on Craig and Casement Islands. Here the older syenite is a massive to foliated, medium- to coarse-grained, grey, muscovite-biotite nepheline syenite containing minor corundum.

POTASSIC SYENITE

Metamorphosed potassic syenites (unit 18) occur as sills in the Hermon and Mayo Group strata in the northwestern and southeastern parts of the map-area. These sills, which may represent more than one period of intrusion in the northwestern part of the area, were subsequently deformed, metamorphosed and intruded by a younger syntectonic suite of granodioritic plutons (unit 19) during the first major deformation event that effected the Grenville Supergroup in this region. In the southeastern part of the map-area, potassic syenites intrude and metasomatize segments of the older Blue Mountain Nepheline Syenite Complex (unit 17). These alkalic rocks, together with the rocks of the Grenville Supergroup were subsequently intruded by plutons of granite to locally granodiorite composition (unit 20).

The potassic syenites are medium grained to coarse grained, and vary in texture from massive to foliated. In places they are layered. They vary in colour from pink to red, brown and yellowish brown. The darker colours are caused by hematite staining of the feldspars. Pink varieties include leucocratic syenite, biotite syenite and locally quartz syenite. These lighter coloured varieties are generally massive to foliated and in thin section they are seen to consist of a hypidiomorphic to granoblastic assemblage of sodic plagioclase, microcline, subordinate microperthite and minor biotite (less than 5 percent). The darker reddish- to yellowish-brown varieties are generally foliated biotite-hornblende syenite and locally gneissic layered hornblende syenite. In thin section, these rocks are seen to consist of a heteroblastic assemblage of sodic plagioclase, microcline, subordinate hornblende and biotite. Combined, the mafic minerals average between 5 - 10 percent of the rock and in places may comprise up to 20 percent. Accessory minerals in all these potassic syenites are magnetite, apatite and titanite.

The fabric of the potassic syenite parallels that of the country rock. Adjacent to marble, syenite-host rock contacts are relatively sharp. Adjacent to nepheline syenite or mafic mineral-rich metasediments or metavolcanics, syenite-host contacts are commonly gradational over short distances because of strong metasomatic alteration of the country rock by the syenite.

In the northwestern part of the area, pink massive to foliated leucocratic syenite to darker biotite syenite is the dominant lithology: (1) in the large northeast trending sill in southeast Galway Township; and (2) in the cross-faulted and gradationally bounded, lense-shaped syenite body that is almost completely enclosed within the North Squaw River granodioritic pluton in southwest Cavendish Township. Gneissic layered varieties of pink biotite and locally red, biotite-hornblende syenite are present along the margins of these intrusions. In contrast, the smaller sills in the metavolcanics to the east in southern Cavendish and northern Harvey Townships are predominantly red to brown, foliated to layered biotite-hornblende syenite. Near contacts with the mafic mineral-rich country rock, a crude layering may be imparted to the syenite gneiss by discontinuous, thin, lamellar segregations of porphyroblastic hornblende and biotite.

In the southeastern part of the map area to the south and southeast of Jack Lake, red to brown, foliated, in places layered biotite-hornblende syenite is the dominant lithology in all the sills. Gradational phases of pink, foliated biotite syenite were observed locally in the large sill near Nephton along the east-central boundary of the map area. This sill occupies the core of the southeast plunging Blue Mountain anticline. In most places the Wall Rocks are Hermon Group strata, however, in places along the eastern flank of this fold, the potassic syenite forms the hanging wall for the older nepheline syenite. To the southwest of Blue Mountain on Stoney Lake a similar but narrower potassic syenite sill occurs at almost the same stratigraphic level in the Hermon Group near its contact with the Mayo Group. As previously mentioned, the potassic syenite gneisses exposed on Craig and Casement Islands in Stoney Lake contain several small, discontinuous, gradationally bounded lenticular bodies of metasomatized older nepheline syenite.

METAMORPHOSED GRANITIC INTRUSIVE ROCKS

INTRODUCTION

Metamorphosed granitic intrusive rocks in the map-area have been subdivided on the basis of their dominant lithology, fabric and distribution into the following two major lithological groups:

1. Map-unit 19a and b consist of foliated, in places layered intermediate to felsic intrusive rocks of granodiorite to granite composition that occur within and to the west of the Burleigh Dome, i.e., the domain of the Harvey-Cardiff Basement Arch.
2. Map-unit 20 comprises massive to weakly foliated and locally lineated felsic intrusive rocks of predominantly granite composition that occur to the east of the Burleigh Dome.

In the present map area the age relationship between the western metamorphosed granodioritic suite and the eastern, less deformed but also metamorphosed granitic suite is not clear because no radiometric age determinations exist for these rocks. Both suites display, to varying degrees, the effects of the 1140 to 1000 Ma old Grenville Orogeny (Stockwell, 1982) and accompanying high rank metamorphism usually in the form of a weak or pronounced gneissosity. The author has tentatively correlated these rocks with the early suite of sodic to locally potassic granitic plutons to the east of the map-area in the Bancroft-Madoc area (No. 1, fig. 7) that were dated by Silver and Lumbers (1966) at approximately 1225 to 1150 Ma. The Elzevir pluton gave a zircon U-Pb age of 1226±25 Ma (Lumbers, 1967b), which may be taken as the peak of this first major metamorphic-intrusive event in the Bancroft-Burleigh Falls-Madoc area.

METAMORPHOSED INTERMEDIATE TO FELSIC INTRUSIVE ROCKS

Within and to the west of the Burleigh Dome, small plutons sills and dikes of metamorphosed granodiorite to granite (unit 19) intrude the Grenville Supergroup and also the mafic and potassic syenite sills within the supergroup. Intrusive bodies of predominantly granodiorite composition with minor phases of granite, quartz monzonite and quartz diorite (unit 19a) occur mainly in the Hermon Group strata to the west and northwest of the dome, i.e., the Squaw River, North Squaw River and Voltuero Lake plutons. In contrast, intrusive bodies of predominantly granite and quartz monzonite composition, such as the Gold Lake and Wolf Lake plutons containing minor phases of granodiorite (unit 19b) occur in the Hermon Group strata along the northern and northeastern flanks of the Burleigh Dome. These granitic stocks and sills are smaller than most of the granodioritic plutons and sills in the Hermon Group to the west of the dome.

The Anstruther Lake Group metasediments are also intruded by these rocks. Most intrusions in this group are small sills and dikes of metamorphosed granite, in places granodiorite that are too small to be shown on the map (back pocket).

The granodiorites (unit 19a) are fine to medium grained, foliated, locally layered and vary in colour from pinkish-grey to medium grey. The most abundant varieties are biotite granodiorite and biotite-hornblende granodiorite. In thin sections these rocks are seen to consist of a granoblastic assemblage of oligoclase-andesine, quartz and potassic feldspar with up to 15 percent combined biotite and minor hornblende. Biotite, lenticular quartz aggregates, and lenticular aggregates of biotite, hornblende and magnetite define the foliation. Locally biotite flakes and quartz aggregates also define a lineation.

With increasing hornblende content, particularly adjacent to mafic metavolcanic country rocks, the central granodiorite to locally granite phase of many of the larger plutons grade into a marginal phase of mottled grey to dark grey, foliated, locally layered quartz diorite containing abundant mafic xenoliths of the country rock metavolcanics and metasediments.

The fabric of these granodioritic intrusive bodies parallels that of the country rock. Contacts of these plutons and sills with the Grenville Supergroup strata are conformable to locally disconformable and vary from relatively sharp to gradational over distances up to 10 m. Adjacent to the mafic to intermediate metavolcanics, in the northwestern part of the map-area, the margins of the Voltuero Lake pluton generally become finer grained within 15 m of its contacts. Country rock xenoliths are locally abundant and intrusive contact breccia zones may be present. Gradational, contact zones of fine-grained, foliated, locally layered, pinkish-grey granodiorite to granite are common adjacent to the intermediate to felsic metavolcanics and the siliceous clastic metasediments. Contacts with the older potassic syenite sills in Cavendish and Galway Townships are relatively sharp with narrow gradational hybrid transition zones separating the two lithologies.

The granites and quartz monzonites (unit 19b) are medium to coarse grained, foliated, and locally layered. The vary from pink, leucocratic granite to pink and pinkish-grey biotite granite and quartz monzonite. Potassic feldspar commonly forms subrounded porphyroblasts or porphyroblastic aggregates in the foliated, locally layered, contact zones of these granite to quartz monzonite stocks and sills. In thin section these rocks are granoblastic and consist mainly of oligoclase, potassic feldspar and quartz with between 0.5 and 8 percent biotite. Biotite flakes and lenticular quartz aggregates define the foliation. Minor hornblende and muscovite are locally present, however, the main accessory mineral is magnetite.

To the west of the Burleigh Dome, granitic rocks of similar composition and fabric generally occur as minor marginal phases in the larger granodiorite plutons and sills near their contacts with intermediate to felsic metavolcanics. The fabric of these marginal phases parallels that of the country rock. Contacts are relatively sharp adjacent to metawacke, para-amphibolite and marble but gradational over several meters with feldspathic meta-arenite and intermediate to felsic metavolcanics. However, near Highway 36, in northwestern Harvey Township granitic rocks predominate in the southern end of the 11 km long, lenticular Squaw River pluton that occupies the core of the Squaw River anticline. The dominant lithologies in this southern cross-faulted segment of the Squaw River pluton are fine to medium grained exposures of pink, weakly foliated leucocratic granite to quartz monzonite, and pinkish-grey, foliated, locally layered biotite granite to quartz monzonite. Near and along the margins of this southern segment of the Squaw River pluton, foliated to gneissic layered, rather dark biotite granite to quartz monzonite are the dominant rock types; however, leucocratic phases are also locally abundant. Contacts between the major granitic phases with the intermediate to felsic metavolcanics are generally gradational. Locally zones of northeast-trending shearing and fracturing separate foliated from gneissic layered phases. In several places along Highway 36, to the east and west of the Squaw River, the foliated, locally layered granite-quartz monzonite contains more massive-looking phases with local zones of magnetite-enrichment. Disseminated magnetite grains, and 14 mm to 3 cm clots and elongated aggregates of magnetite, hornblende-magnetite, or biotite-hornblende- magnetite (Morton, 1983) may compose up to 30 percent of the rock. Contacts between these magnetite-bearing massive zones and the foliated or gneissic layered granitic phases are either gradational or marked by zones of weak fracturing and shearing.

This southern segment of the Squaw River pluton is interpreted by the author to be a hybrid, wall-rock assimilation phase of the granodiorite, the dominant lithology throughout the central and northern part of this pluton. This portion of the pluton is however, considered by Morton (1983), to be an older synvolcanic intrusive body that is intruded by the granodiorite pluton to the north in the vicinity of the northeasterly trending cross-fault shown on the map, just to the north of Highway 36.

METAMORPHOSED FELSIC INTRUSIVE ROCKS

To the east of the Burleigh Dome, small plutons, sills and dikes of metamorphosed granite with minor phases of granodiorite (unit 20) intrude the metavolcanics and metasediments of the Hermon Group. The Mayo Group metasediments are also intruded by these rocks, however, in the carbonate rocks of this group the various intrusive bodies are generally smaller and less deformed than those that intrude the Hermon Group strata. Along the eastern boundary of the map area, to the east of Stoney Lake, the Hermon Group strata are intruded by two related granitic intrusions: (1) the Methuen granite pluton; and (2) the Horse Lake crescent-shaped granite dike that intruded along the contact between the Hermon Group strata and the oval-shaped Horse Lake diorite-gabbro sill. Both intrusions extend considerable distances to the east of the map-area and have been described in detail by Hewitt (1961).

METHUEN GRANITE

According to Hewitt (1961), the 20 km long, lenticular-Methuen granite pluton is rather uniform in composition and varies in texture from massive to foliated and lineated. The pluton is composed mainly of medium- to coarse-grained, pink biotite granite with minor phases of pink, leucocratic granite with less than 1 percent biotite, finer-grained, grey, biotite granodiorite and locally pink, porphyritic biotite granite. Tecturally the granite grades from hypidiomorphic granular and locally porphyritic to granoblastic and locally porphyroblastic. Modal analyses (Hewitt, 1961) of the dominant pink biotite granite phase show that the plagioclase (andesine) content ranges from 23.3 to 45.3 percent, quartz from 19.8 to 41.0 percent and the microcline content ranges from 15.3 to 38.2 percent. Perthite generally comprises less than 5 percent of the rock and the combined content of biotite and less abundant hornblende ranges from 2.2 to 9.6 percent.

At its southwestern end, the Methuen Pluton has a narrow central phase of medium- to coarse-grained massive to weakly foliated and lineated, pink biotite granite. Its broader marginal zonal consists of foliated, lineated, locally layered, pinkish grey hornblende-biotite granite, biotite-hornblende granite and minor granodiorite. In a thin section taken by Hewitt (1961) from the marginal zone, the rock consisted of 23.3 % plagioclase (An_{38}), 34.1% quartz, 36.8% microcline, 0.8% perthite, 4.1% hornblende and 0.9% biotite with minor opaque minerals.

At the western end of the pluton near Stoney Lake, contacts between the granite and the wall rock mafic metavolcanics are generally sharp. Inclusions of wall rock metavolcanics are locally abundant in the contact zone of the pluton and narrow, lit-par-lit injection dikes of granite and hybrid granite are common in the country rock metavolcanics.

HORSE LAKE GRANITE

The Horse Lake crecentic granite dike lies to the south of the Methuen Pluton at the eastern end of Stoney Lake. It is coarser grained and contains more mafic minerals than the Methuen granite. Wall rock inclusions are also much more abundant throughout this intrusion than in the marginal zone of the Methuen pluton. Major phases in order of increasing abundance at the western end of the Horse Lake granite are: (1) pinkish-grey, medium- to coarse-grained, foliated, in places layered hornblende-biotite granite; (2) pink, coarse-grained, weakly foliated, porphyritic biotite granite; and (3) pink, foliated biotite granite. Minor phases locally present near contacts with the Horse Lake mafic sill or the mafic metavolcanics are foliated to locally gneissic layered granodiorite and quartz diorite. Modal analyses by Hewitt (1961) from within and to the east of the map-area gave the following results: the plagioclase (An_{20-21}) content ranges from 24.4 - 40.8 percent; quartz, 17.7 - 25.5 percent; microcline and microcline microperthite 12.6 - 32.1 percent. Total mafic minerals range from 18.3 - 30.9 percent, with biotite being most abundant.

The contact of the Horse Lake granite dike with the marbles near Stoney Lake is sharp. Elsewhere contacts with the metavolcanics and the Horse Lake mafic sill are gradational through transition zones of hybrid granitic gneiss. In these transitional contact zones, amphibolite xenoliths are common and locally, large inclusions of quartzofeldspathic country rock are abundant.

OTHER GRANITIC INTRUSIVE ROCKS

The metasediments and metavolcanics of the Hermon Group exposed along the shores and to the south of Stoney Lake are intruded by several small stocks, e.g. the Quarry Bay stock, that are similar to the Methuen Pluton. Pink medium- to coarse-grained foliated biotite granite, containing up to 5 percent biotite and occasionally minor hornblende is the main rock in this stock. Subordinate phases of pink leucocratic granite and locally minor porphyritic biotite granite are also present. Contacts with Hermon Group strata are similar to the transitional contacts of the Horse Lake granite dike.

In eastern Burleigh Township, between Stoney Lake and Jack Lake, marbles of the Mayo Group have been intruded by several small stocks and numerous sills and dikes of metamorphosed, pink, leucocratic granite and biotite granite. These granites are generally fine to medium grained and vary in texture from massive to foliated. Contacts are sharp adjacent to marbles and feldspathic meta-arenites of the Mayo Group and finer-grained, chilled margins may be preserved in the contact zones of some of the stocks and sills. Contacts with metawacke of the Mayo Group are gradational through narrow transition zones of hybrid granite gneiss.

LATE GRANITIC INTRUSIVE ROCKS

Relatively unmetamorphosed, late granitic rocks (unit 21) occur as small stocks and dikes at several places in northern

Harvey and southeastern Cavendish Townships, to the north and west of the Burleigh Dome. Most of the dikes are too small to be shown on the map (back pocket). To the east of the Burleigh Dome, in Burleigh and Methuen Townships small stocks of unmetamorphosed granite are absent and dikes are uncommon. In this region of the map-area, the distinction between "late granitic intrusive rocks" and "metamorphosed felsic intrusive rocks" described above is not always possible.

In the western part of the area the late granitic rocks (unit 21) are pink, red and pinkish-grey, medium- to coarse-grained, massive biotite and hornblende-biotite granite. They generally contain between 1 - 10 percent biotite with minor hornblende present in places. Texturally these rocks are massive, in places subporphyritic and consists of plagioclase (oligoclase-andesine), microcline and microperthitic microcline and quartz. Magnetite is the main accessory mineral.

Contacts of the stocks and large dikes are sharp; chilled margins are common and mafic xenoliths are locally abundant common near contacts with mafic metavolcanics, para-amphibolite and metawacke. A weak to moderate foliation and/or lineation delineated by oriented biotite and hornblende may be present near the contacts of the larger bodies.

Smaller granite dikes intruding the rocks of the Hermon and Mayo Groups as well as the older mafic, alkalic and felsic plutonic rocks in this region of the map-area are generally fine to medium grained, massive throughout and seldom contain more than 5 percent biotite with hornblende rarely present.

Similar narrow, granitic dikes, most of which are too small to be shown on the map (back pocket) also intrude the Anstruther Lake Group migmatitic metasediments along the flanks of the Burleigh Dome. In some places along Highway 36 to the west of Burleigh Falls, pink, massive leucocratic and medium grey biotite granite dikes are very common and up to 50 percent of some exposures shown as Anstruther Lake Group migmatitic meta-arenites and metawackes may consist of dikes of these late granites. The intervening country rock metasediments adjacent to the granite dikes may locally take on the appearance of an inhomogenous granitic to granodioritic diatexite. The massive dikes themselves may contain irregular, gradational marginal phases of pegmatitic, foliated biotite granite. Cross-cuttings relationships between granitic dikes were observed in several places.

LATE MAFIC INTRUSIVE ROCKS

Late mafic intrusive rocks (unit 22) of possibly more than one age, form narrow concordant to discordant dikes in the map-area. The dikes vary from 15 cm to 7 m in width and generally have sharp contacts with adjacent units. These dikes are mainly: (1) fine-grained massive to foliated amphibolite; (2) medium- to coarse-grained dark greenish to black, massive, in places weakly foliated gabbro and diabase containing well preserved igneous textures; and (3) minor biotite lamprophyre. No detailed petrological study of these mafic dikes has been made by the author and many of these dikes are too small to be shown on the map (back pocket).

The age relationship between some of these dikes and the late tectonic pegmatitic granite dikes is not clear. In the marbles near Jack Lake in the northeastern part of the area, pegmatitic granite dikes (unit 23) were observed in several places to cross-cut fine- to medium-grained, foliated, dark grey to black mafic dikes. To the north of Jack Lake, numerous narrow, fine-grained mafic dikes intrude the Apsley Formation metasediments and in several roadcuts along the secondary access road between Apsley and Jack Lake, late tectonic pegmatitic granite dikes and related veinlets intruded along and locally across contacts between these late mafic dikes and the metasediments.

In the southern part of the map-area, north of Buckhorn and west of Burleigh Falls late mafic dikes also intrude the Anstruther Lake Group metasediments. In several road side outcrops along Highway 36 to the west of Burleigh Falls, 1 - 5 m thick dikes of medium- to coarse-grained, massive to foliated metagabbro and locally fine-grained amphibolite intrude tightly folded and boudinaged Anstruther Lake Group metasediments. The trend and fabric of these mafic dikes varies with the local pattern of deformation of the country rock metasediments. In areas where secondary drag folds and boudins are absent in the country rock, the dikes trend parallel to and locally cross-cut the undulating trend of the layering in the metasediments. Contacts are sharp and chilled margins are present in many dikes. Altered country rock xenoliths were observed locally. Some dikes locally break down into discontinuous boudin-shaped lenses that trend parallel to the fabric of the country rock.

Late tectonic pegmatitic granite dikes were observed cross-cutting both undeformed as well as deformed segments of these mafic dikes.

In contrast to this pre-pegmatite age relationship, a narrow, fine- to medium-grained, massive, dark grey biotite lamprophyre dike was observed to cut one of the large pegmatitic granite dikes in the marble to the west of Catchacoma Lake, in central Cavendish Township. For mapping purposes this post-pegmatite dike has been included with this group of mafic dikes.

LATE PEGMATITIC GRANITE DIKES

Late tectonic dikes of leucocratic pegmatitic granite and granite pegmatite (unit 23) intrude all the previously described lithologies in the map area except for a single occurrence of a younger biotite lamprophyre dike. These pegmatitic dikes were emplaced at several stages during the waning stages of the Grenville Orogeny and accompanying high rank regional metamorphism. U-Pb radiometric ages from uraninite and zircon obtained from 28 different pegmatites in the Bancroft- Madoc region range from 1,076 to 959 Ma with an average of 1,018 Ma (Douglas, 1982).

These dikes are predominantly pinkish-white to pink, massive, medium- to coarse-grained, leucocratic granite, pegmatitic granite and granite pegmatite. The main rock-forming minerals are quartz, albite and microcline microperthite; in places antiperthite is present. Biotite and magnetite, the characteristic assessory minerals, seldom exceed one percent of the rock. The biotite and magnetite content increases markedly in contact alteration zones adjacent to mafic mineral-rich wall rocks or locally where mafic mineral-rich xenoliths occur in the dikes. Minor hornblende may also be present in these biotite and magnetite richer rocks.

The pegmatites occur mainly as single dikes that range in size from 5 cm - 3 m thick and 10's of meters long to large bodies, like the dike that hosts the Cavendish uranium deposit (deposit No. 16 on map in back pocket). This dike is about 90 m thick and has a strike length of over 3 km (Bright, 1980). These dikes generally trend parallel to the primary and/or metamorphic layering of wall rock metasediments and metavolcanics and the foliation in the older suites of metamorphosed mafic, alkalic and felsic plutonic rocks. Older massive mafic to felsic plutonic rocks are generally cross-cut or intruded along their contact by the pegmatite dikes. Along strike some dikes may branch and later rejoin as one dike, while others break down into zones of en echelon dikes.

Wall rock assimilation and reaction along the margins of many of the pegmatite dikes has produced the following desilicated, hybrid phases within the pegmatites: (1) biotite and hornblende-biotite granite; (2) hornblende- and pyroxene-bearing quartz-poor granite; (3) hornblende and pyroxene syenite and pegmatitic syenite; and (4) leucocratic syenite and pegmatitic syenite. These hybrid phases are commonly pink to brick-red, due to hematite-staining of the feldspars and exhibit grain size variations from fine- to coarse-grained over short distances.

Rapid local changes in texture from massive to foliated are also not uncommon. Accessories that may occur in these hybrid phases are allanite, zircon, titanite, fluorite, calcite, apatite, pyrite, pyrrhotite, chalcopyrite, molybdenite and in places uranothorite and uraninite.

In the map area, the late tectonic pegmatitic granitic dikes are more abundant in the Anstruther and Hermon Group strata along the flanks of the Burleigh Dome than in the marble-rich Mayo Group that underlie the synclinoriums to the east and west of this dome. Most of these dikes are too small to be shown on the map (back pocket). Local swarms of narrow, closely spaced, en echelon dikes, branching dikes and lenses are common in both the meta-arenite-rich Anstruther Group and the metavolcanic-rich Hermon Group. However larger dikes and dikes containing abundant hybrid phases and in places economically interesting uranium mineralization are concentrated in the Hermon Group metasediments and metavolcanics along the flanks of the Burleigh Dome and adjacent flanks of the Anstruther Dome.

PALEOZOIC

CAMBRO-ORDOVICIAN AND MIDDLE ORDOVICIAN

The Paleozoic rocks in the southern part of the map-area are, Cambro-Ordovician to Ordovician (Liberty, 1969). Except for some of the small outliers exposed along Highway 36, west of Burleigh Falls, these rocks were not studied by the author in any detail and the following account is based on the reconnaissance work by Carson (1980).

In the map-area, the Paleozoic-Precambrian boundary extends from Pigeon Lake on the west through, or slightly north of, Lower Buckhorn Lake, Lovesick Lake, Clear Lake and Stoney Lake. North of these lakes flat-lying Paleozoic rocks, in places, occur as discrete outliers ranging in size from a few hundred square metres to more than 15 km^2.

The Paleozoic strata have been subdivided by Carson (1980) into the following two groups: (1) a Basal Group of Cambro-Ordovician age; and (2) the Simcoe Group of Middle Ordovician age.

The Basal Group, of which only the Shadow Lake Formation occurs in the map area, is exposed north of Lower Buckhorn Lake and at the base of small scarps along the southern shores of Stoney Lake. The formation consists of red and green shales, siltstone and sandstones. At the Precambrian-Paleozoic unconformity, the formation consists of a deep red arkosic grit with quartz clasts up to 4 cm in diameter. The thickest exposure of the formation, up to 5 m, is located on Highway 36, west of Burleigh Falls.

The Simcoe Group, which in the map area consists of, in ascending order, the Gull River Formation and the Bobcaygeon Formation, makes up more than 90 percent of the exposed Paleozoic strata. The Gull River Formation, the main unit in the outliers, consists of pale grey to pale and medium brown and brown-grey lithographic limestones. The best exposure of the formation occurs in the outlier near Woodview along Highway 28, east of Burleigh Falls.

The Bobcaygeon Formation forms the main Paleozoic unit south of the Paleozoic-Precambrian boundary in the Burleigh Falls area. It consists of a lower unit of predominantly fine- to medium-grained, fossiliferous, grey to brown limestone and an upper unit of fine- to medium-grained, brown, bioclastic limestone. The formation is exposed at several places along Highway 36 near Buckhorn.

CENOZOIC QUATERNARY

PLEISTOCENE AND RECENT

The glacial deposits within the map-area are probably Wisconsinan in age. Striae and associated ice-flow features indicate ice movement of about 19° west of south over the region (Henderson 1973).

Thin discontinuous deposits of silty to sandy and locally stoney till overlie the Precambrian bedrock along the flanks of hills above an elevation of about 330m above sea level, particularly the large areas of exposed bedrock that occur in the region of the Burleigh Dome. Below this elevation, most of the area is underlain by glaciofluvial sand and gravelly sand which, in places, are interstratified with ground morrain material.

In the western part of the area, the thickest and most extensive glaciofluvial deposits of sand and gravelly sand with local accumulations of gravel, are concentrated in the following low-lying areas that once served as southward glacial meltwater channels: (1) the Crystal Lake-Nogies Creek drainage system that cuts through the marbles in Galway Township; and (2) the Catchacoma Lake-Mississagua River drainage system cutting through the metasediments and metavolcanics along the western flank of the Burleigh Dome.

In the eastern part of the area the marbles to the west of the Burleigh Dome are blanketed by thick glaciofluvial outwash sand deposits. Recent sand and silt deposits occur along large lakes and river systems. Small bog and swamp deposits are locally common.

ARCHEOLOGY

Petroglyph Provincial Park is located north of Stoney Lake in southeastern Burleigh Township. It is well known for its indian petroglyphs (Photo 16), estimated to be anywhere from 500 to 3,500 years old. The petroglyphs are carved into the surface of a deformed, flat-lying bed of white crystalline marble. The location of the petroglyphs is shown on the map (in back pocket).

STRUCTURAL GEOLOGY AND METAMORPHISM

FOLDING AND METAMORPHISM

The Middle Proterozoic rocks in the Burleigh Falls-Bancroft region were subjected to at least two major periods of deformation accompanied by regional metamorphism between approximately 1,240 Ma and 1,000 Ma (Silver and Lumbers 1966, Douglas 1982). The earliest orogeny in the Bancroft-Madoc area (area no. 1, Fig. 2) just to the east of the map-area is named the Elzevirian Orogeny (Stockwell, 1982). The intrusion of the Elzevir trondhjemite- granodiorite pluton (shown on Fig. 7), which gave a zircon "U-Pb" age of 1,226±25 Ma (Stockwell, 1982) took place during this orogeny. This radiometric age of crystallization is taken as the peak of this orogeny. Lumbers (1967b) believes that the Weslemkoon and Elzevir granodioritic plutons (Fig. 7) were emplaced at this same time and that a related series of more granitic plutons including such bodies as the Methuen granite in the map area were emplaced during a slightly younger period of related syntectonic granitic activity. This orogeny is considered by Stockwell (1982) to have lasted until about 1,180 Ma. All these rocks were subsequently subjected to the Grenville Orogeny between 1,140 and 1,000 Ma (Stockwell, 1982).

The Burleigh Dome, forms the southern end of the Harvey-Cardiff Basement Arch, an 80 km long and 25 km wide, northeasterly-trending zone of basement uplift between Burleigh Falls and Bancroft. This regional arch contains a linear series of five major domes (see Fig. 7), that were selective centers of basement uplift, and granitic plutonism, first during the Elzevirian and later during the Grenville Orogeny.

During the early stages of the Elzevirian Orogeny, prior to the development of the Burleigh and Anstruther domes, the author suggests that the relatively flat-lying strata of the Grenville Supergroup was intruded by early tectonic suites of mafic, and sodic to potassic alkalic sills (units 16 and 17 and 18 respectively). During the later stages of this same orogeny, the development of the domes was initiated and the interlayered Grenville Supergroup strata and mafic and alkalic sills were subsequently deformed and regionally metamorphased along the flanks of the domes. A series of north to northeast trending, regional folds were developed along the flanks of the rising domes, parallel to the regional trend of the Harvey-Cardiff Basement Arch. At this same time, syntectonic granitic plutons, like the Methuen granite were emplaced into the supracrustal succession. Local easterly-trending folds probably developed between the domes and around these plutons. The regional grade of metamorphism attained during this deformation is unknown.

During the later Grenville Orogeny, renewed uplift, regional folding and granitic plutonism along and adjacent to the arch augmented the earlier northeasterly-trending structures in the map area. At successive stages during the Grenville deformation: 1) the older Elzevirian folds were refolded into a new series of regional north to northeast trending folds; 2) secondary easterly trending folds developed synchronously between uplifted domes; 3) regional overturning to the west of all major structures, including the domes during westerly-directed thrust-faulting; and 4) slightly younger easterly trending cross-folds developed around late tectonic granite plutons.

The Burleigh Dome and its flanking synclinorium dominate the structures of the map area. The main aspects of these structural features are summarized below.

The fault-bounded and cross-faulted 13 km wide, elliptical oval Burleigh Dome may be a composite structure consisting of two closely spaced centres of uplift: (1) a major centre between Buckhorn Lake and Crane Lake in northeastern Harvey Township that surrounds a complex of amphibolite-grade basement migmatites and gneisses; and (2) a subordinate centre to the east between Loon Lake and Long Lake in northwestern Burleigh Township that was intruded by syntectonic metamorphosed granitic pluton. A pronounced stratiform gneissossity in the amphibolite-grade

Anstruther Lake Group metasediments, that surround these two centres of uplift within the dome, dips subhorizontally (0-10°) to shallowly (10° - 30°) away from these centres towards the more steeply dipping Hermon Group strata along the margins of the dome.

West of the Burleigh Dome in northwest Cavendish and Galway Townships is a large, northeasterly-trending, westerly overturned synclinorium termed the Galway Synclinorium by the author. The major axis of this synclorium lies northwest of the map area (Figure 7).

East of the Burleigh Dome, tightly folded rocks of the Hermon and Mayo Groups occupy the southern end of another northeasterly-trending, westerly overturned synclinorium termed the Chandos Synclinorium by the author. Its major axis through the carbonate and other metasediments in eastern Burleigh Township is shown on Figure 7. A northeast-trending linear series of syntectonic granitic plutons, which includes the Methuen Pluton along the eastern boundary of the map area, marks the eastern limb of this regional structure. In the northeast corner of the map area, the Chandos Synclinorium has undergone regional east-west cross-folding, which possibly accompanied the emplacement of the late tectonic Loon Lake granitic stock to the north of the map area in the adjacent Eels Lake area (Bright, 1980). Similar intrusions with accompanying cross-folding occur along the southern margin of this synclinorium. Near the southern end of the cross-folded Chandos Synclinorium, secondary northwesterly-overturned to recumbent folds in the Mayo Group marbles can be observed along the access road around Young Bay on Stoney Lake and along Highway 28, north of Haultain.

A pervasive southeast plunging lineation is present in many of the supracrustal rocks and the early to syntectonic plutonic rocks along and to the northwest of the Harvey-Cardiff Basement Arch. This fabric probably developed during regional overturning and synchronous thrust-faulting of the arch and its flanking synclinoriums to the west. To theeast of this arch a southeast plunging lineation is locally developed in the rocks, however this penatrative fabric decreases rapidly in intensity towards the southeast part of the map-area.

FAULTING

All the bedrock, including the late tectonic pegmatitic granite dikes, are fractured, sheared, and offset by three regional fault systems. The trace of most of the faults shown on the accompanying map (back pocket) has been interpreted from: (1) major offsets in lithology and stratigraphy defined during field mapping; (2) truncations or offsets of aeromagnetic trends; (3) major lineaments observed on aerial photographs and (4) observation of cataclastic textures.

The oldest fault system consists of east-northeast trending and south dipping thrust faults accompanied by shearing and cataclasis. In a few cases where these fault zones were directly observed by the author, the shearing dipped 30 to 40 degrees to the north. This oldest fault system is offset by a younger system of north-northeasterly-trending faults, many of which dip 35 to 60 degrees east. The youngest system is made up of steeply dipping normal faults that trend in a north to northwesterly direction.

On the map (back pocket), the author indicates that most Paleozoic outliers either lie within or straddle major zones of northeast-trending block-faulting in the Precambrian basement. At the western end of the first small outlier along Highway 36, west of Burleigh Falls, undisturbed, flat-lying Paleozoic strata sharply overlie a 5 m wide, northeast-trending and east-dipping zone of shearing in the Anstruther Lake Group metasediments. This indicates that these faults are Precambrian image and that no re-activation of the northeastern faulting at least at this location occurred after the deposition of the Paleozoic rocks.

ECONOMIC GEOLOGY

Mineral exploration in the Burleigh Falls area was initiated just before the turn of the century by the discovery of nepheline and corundum in some of the alkalic syenite gneisses. Subsequent prospecting for base metals, iron and industrial mineral deposits, particularly mica, apatite, nepheline and feldspar, was carried out intermittently for the next 30 years. Commercial development of nepheline syenite at Blue Mountain, near Nephton in southwestern Methuen Township commenced in 1936 and has continued, uninterrupted, to the present. Indusmin Limited (property No. 10) is the operator of the nepheline syenite deposits in the map-area. Another deposit lies just to the northeast of the map-area and is operated by Sobin Chemicals

(Canada) Limited.

Following the discovery of economic uranium deposits near Bancroft, most of the exploration in the map area since the 1950's has been directed toward the re-evaluation of known uranium deposits as well as a search for new uranium deposits. Periods of peak activity occurred during the mid-1950's, the late 1960's and the mid-1970's. Production feasibility studies were carried out in the late 1970's by Rare Earth Resources Limited and its partner Imperial Oil Limited (Esso Resources Canada Limited) on the Cavendish uranium deposit to the west of Catchacoma Lake in Cavendish Township. Similar studies were made by Camindex Mines Limited on the Loon Call Lake uranium deposit in southeastern Anstruther Township (also see Table 5).

Since 1974, a small vermiculite deposit on Catchacoma Lake has been under study by Insulite Development Corporation Incorporated. To date there has been little recorded exploration effort directed towards the base-metal potential of the area.

Locations of major mineral deposits are shown with numbers on the accompanying map (in back pocket). Small base metal occurrences are also indicated on this map.

IRON AND BASE-METAL MINERALIZATION

STRATABOUND IRON OXIDE AND IRON SULPHIDE DEPOSITS IN MARBLE

Small deposits of magnetite and hematite as well as pyrite and pyrrhotite with minor associated base-metal mineralization occur stratabound in the marbles of the Hermon Group.

In Cavendish Township along the west shore of Catchacoma Lake, the deposits consist mainly of disseminated to massive pyrite and pyrrhotite along contacts between marble and thin interstratified units of rusty metaquartzarenite and/or recrystallized chert. Massive layers of pyrite and pyrrhotite up to 3.7 m thick occur in marble on the N1/2 lot 18, Con. IV and the S1/2 Lot 18, Con. V, Cavendish Township. Within the same marble unit, approximately 5 km along strike to the north of the map area on the S1/2 Lot 16, Conc. X, Cavendish Township in the adjacent Eels Lake area, a 1.5 m wide band of massive pyrrhotite-pyrite contains minor copper and silver mineralization (Bright, 1980).

Elsewhere in the same township, this same marble unit contains the following: (1) thin layers of massive hematite and magnetite on N1/2 lot 14, Con. I and the S1/2 Lot 14, Con. II; and (2) rusty weathering pyritic quartzofeldspathic schist along the west shore of Mississagua Lake on N1/2 Lot 21, Con. I, Cavendish Township.

In Galway Township, immediately to the west of Cavendish Township, on N1/2 Lot 27, Con. V, rusty pyritic, quartzofeldspathic schist occurs in Hermon Group marble adjacent to mafic metavolcanics. To the south in central Harvey Township between Sandy and Big Bald Lake, disseminated pyrite and minor sphalerite (Morton, 1983) occur in the marble near the overlying and locally intercalated mafic metavolcanics.

These minor occurrences within the map area, together with the larger marble-hosted magnetite deposit of Byron Bay Gold Mines Limited (Bright, 1980, 1981a) to the north of the map-area in northern Anstruther Township, reflect a regional pattern of syngenetic iron oxide and iron sulphide mineralization in the Hermon Group marbles.

SULPHIDE MINERALIZATION IN METAVOLCANICS

The Cavendish-Harvey metavolcanics, along the western flank of the Anstruther and Burleigh Domes have the highest potential for base-metal sulphide mineralization in the map-area. This tholeiitic mafic to felsic metavolcanic sequence contains numerous sulphide occurrences. In the eastern part of the map-area, the much thinner Stoney Lake tholeiitic to calc-alkaline mafic to felsic metavolcanic sequence contains only minor sulphide occurrences.

In Harvey Township, Morton (1983) has reported minor zones of disseminated to stringer pyrite mineralization containing minor chalcopyrite occurring at several widespread localities in the Cavendish-Harvey metavolcanics and associated minor intercalated chemical-clastic metasediments. In the lower mafic to intermediate metavolcanic sequence minor pyrite and locally minor pyrrhotite, chalcopyrite (less than 0.5 percent) and rare arsenopyrite and sphalerite occur as disseminations and amydaloidal fillings within flows at the following localities: (1) South of Little Bald Lake on Lots 14-15, Con. XII; (2) north of Little Bald Lake on Lot 16, Con. XIII and Lot 19, Con. IX; and (3) north of Highway No. 36 and west of the Squaw River on Lot 30, Con. IX and Lot 27, Con. XI, Harvey Township. In Harvey Township, the upper intermediate to felsic metavolcanic sequence of the Cavendish-Harvey metavolcanics contains minor disseminated to stringer pyrite mineralization with minor chalcopyrite (less than 0.1 to 0.5 percent) and rare sphalerite at the following localities (Morton, 1983): (1) south of Highway No. 36 and west of the Squaw River on Lot 19, Con. XII; and (2) north of Highway No. 36 and west of the Squaw River on Lot 30, Con. IX and Lot 24, Con. XI and XII.

Sulphide mineralization in interlayered clastic metasediments within these metavolcanics occurs at the following localities (Morton, 1983) in Harvey Township: (1) south of Little Bald Lake on Lot 14-15, Con. XI and Lot 13, Con. XII, as disseminated pyrite blebs and streaks with minor chalcopyrite and sphalerite in rusty weathering muscovite-quartz-feldspar schist and gneiss and (2) north of Little Bald Lake on Lots 18 and 19, Con. XII and XIII, Harvey Township, as disseminated pyrite-minor chalcopyrite mineralization in muscovite and muscovite-biotite quartz-feldspar schist and gneiss within the intermediate to felsic metavolcanics.

To the north of Harvey, in Cavendish Township on Lot 4, Con. IV and Lots 12 and 13, Con. VI, minor disseminated pyrite-pyrrhotite and very minor chalcopyrite mineralization was observed by the author (Bright, 1981b) in the mafic metavolcanics. Minor disseminated pyrite also occurs in the intermediate to felsic metavolcanics north of Mountain Lake on Lot 9, Con. II, Cavendish Township. To the west of Cavendish, in Galway Township on Lot 31, Con. V and Lot 32, Con. VI, a northeast-trending unit of rusty weathering pyritic quartz-feldspar schist and gneiss separates mafic metavolcanics from an underlying, fault-bounded marble unit to the west.

Similar rusty weathering, pyritic quartz-feldspar schist and gneiss units occur in the mafic metavolcanics northeast of Stoney Lake on Lot 5, Con. XI, Burleigh Township. This is the only significant sulphide occurrence observed by the author in the Stoney Lake metavolcanic sequence.

SULPHIDE MINERALIZATION IN FELSIC PLUTONIC ROCKS

In Harvey Township, the southern, sheared, fractured and cross-faulted end of the Squaw River granodiorite pluton is predominantly granitic to quartz monzonitic in composition. This phase of the pluton straddles a major easterly-trending fault and to the north, and locally to the south of this fault, the pluton contains several small sulphide occurrences in local zones of fracturing, shearing and brecciation. Morton (1983) suggests that this granitic phase of the pluton is an older synvolcanic intrusive equivalent of the adjacent intermediate to felsic metavolcanics and not a hybrid phase of the main granodiorite pluton as proposed by the author and shown on the map (back pocket).

Morton (1983) has identified the following three types of mineralization in this granitic phase of the pluton: (1) quartz-magnetite stringers, veins and open space fillings, containing minor disseminated pyrite and chalcopyrite with or without traces of bornite and molybdenite, in breccia zones close to the centre of the pluton; (2) chalcopyrite, molybdenite and pyrite, associated with quartz, potassic-feldspar, and biotite in stringers along the outer margins of the intrusion; and (3) minor disseminated molybdenite, pyrite, and magnetite in calcite fracture fillings, within local zones of intense shearing in the pluton. The chalcopyrite content seldom exceeds 0.1 to 0.5 percent of the host rock (Morton, 1983). North of Highway 36, anomalous but very low uranium values were reported by Imperial Oil Limited (Assessment Files Research Office, Toronto) in similarly mineralized breccia zones in the central region of the pluton on Lot 21, Con. XI, Harvey Township (Property No. 7, Table 5). These various sulphide occurrences were not examined by the author.

Along Highway 36, near the eastern and western margins of this same pluton, Morton (1983) as well as the author observed fractured and sheared phases of the pluton containing local concentrations of magnetite, hornblende-magnetite, or biotite-hornblende-magnetite. These minerals may form clots 14 mm to 3 cm in diameter and comprise up to 30 percent of the rock.

INDUSTRIAL MINERALS

Nepheline Syenite

Commercial open-pit mining of nepheline syenite from the Blue Mountain Nepheline Syenite Complex near Nephton in Methen Township has gone on since 1936. The material is mined for use in the ceramic and glass industry. Output in 1980 was from two major producers: (1) Indusmin Limited, property No. 10 on the map (in back pocket); and (2) Sobin Chemical (Canada) Limited, whose quarry operations lie in the same nepheline syenite complex along strike to the northeast beyond the limits of the map-area.

A summary interpretation of the regional and detailed geology of the Blue Mountain compositionally layered nepheline syenite sill is given in an earlier section of this report dealing with "Metamorphosed Alkalic Intrusive Rocks". The reader is also referred to a more detailed description of this complex by Hewitt (1961) and Payne (1968). For a summary of the historical develop of the Indusmin Limited open pit operations near Nephton see Table I.

Between 1943 - 1970, milling from the various quarries on the property now operated by Indusmin Limited totalled approximately 5,007,000 tons of nepheline syenite (Table I). Quarrying is restricted to selective zones in leucocratic, white muscovite and biotite-muscovite nepheline syenite. This leucocratic phase is white and is composed of albite (54%); nepheline (22%); microcline (20%); and muscovite (20%), with less than 5 percent easily removable mafic minerals, mainly biotite and magnetite (Table I). The chemical composition of the finished product is: Silica, 60.0%, alumina, 23.6%; iron (Fe_2O_3), 0.07%; calcium, 0.03%; magnesia, 0.1%; soda, 10.2% and potash, 5.3% (Hewitt, 1961). In 1975 estimated ore reserves were 20,755,000 tons (O.G.S. Mineral Deposit Inventory Record, Methuen Township, Nephton File).

VERMICULITE

Vermiculite is used in the aggregate, refractory, insulation and fireproofing industries. It is found as disseminations in local sections of pre-Pleistocene, deeply weathered deeply phlogopite marbles in the carbonate metasediments between Catchacoma and Mississagua Lakes in Cavendish Township. Vermiculite-bearing sections of deeply weathered marble are discontinuously exposed on the S1/2 lots 23 and 25, Con. IV. Other showings occur in S1/2 lot 22, Con. IV, and the NW

1/4 lot 14, Con. II, Cavendish Township. Roadcuts show that the upper 1-2m of the bedrock phlogopitic marble has been transformed to a medium-grained calcite sand deposit. In this deposit the structures of the original bedrock are still visible.

The main "A" zone of the Insulite Development Corporation Incorporated vermiculite deposit (No.11, Table I) is located on lots 24 and 25, Con. IV, Cavendish Township. It has been tested by bulldozer trenches and many test pits to depths of up to 1.3m across a 330m wide section. A second zone on this property, the "B" zone is located on lot 23, Con. IV, 400m to the west of the A-zone. It appears to be the lateral extension of the A-zone. By visual estimate, the average tenor of the 1-2m thick weathered marble horizon in both zones is less than 10 percent vermiculite. (Assessment Files Research Office, Toronto.) Locally small lenses in the weathered marble may contain up to 30 percent vermiculite. Exploration to date on this deposit has not been sufficiently detailed to outline reserves.

URANIUM MINERALIZATION

INTRODUCTION

Within the Burleigh Falls area, uranium mineralization is associated with hybrid phases in the late tectonic generally leucocratic,pegmatitic granite dikes that were emplaced throughout the entire region during the waning stages of the Grenville Orogeny. Uraniferous pegmatites occur mainly in the northern part of the map area. Here, dikes, in places dike swarms occur in tightly folded and cross-folded high metamorphic rank, Hermon Group metavolcanics and mafic mineral-rich metasediments along and between the northern flank of the

Burleigh Dome and the adjacent southern flank of the Anstruther Dome. These domes at the southern end of the Harvey-Cardiff Basement Arch, coincides with the southern end of the Bancroft uranium belt (Satterly, 1957).

The northern part of the Bancroft uranium belt, which contains more than 100 documented uranium deposits (Satterly, 1957), coincides with the central and northern part of the Harvey-Cardiff Basement Arch. During the period 1956-1964, the northern part of the belt, i.e., the Bancroft camp, produced a total of about 5,500 tons of U308 worth approximately $105 million, principally from the Faraday and Bicroft deposits (Robertson, 1975).

In the southern part of the Bancroft uranium belt exploration and development in the Burleigh Falls area has outlined the following reserves: (1) 406,000 tons with an average grade of 1.77 lbs U308 per ton in the Camindex Mines Limited (Zenmac-Loon Call Lake) deposit (No. 3) in southeast Anstruther Township; and (2) 435,624 tons with an average grade of 1.92 lbs U308 per ton in the Rare Earth Resources (Cavendish) deposit (No.16) in central Cavendish Township (Robertson, 1975).

The mode of occurrence and history of development of all the uranium deposits in the Burleigh Falls area are shown in Table 5. The uranium mineralization, principally uranothorite and uraninite with minor thorite, allanite and zircon (cyrtolite) occurs mainly as disseminations or fracture-vein fillings in altered phases of the pegmatitic granite dikes. The uranium-bearing pegmatites commonly exhibit irregularly contaminated hybrid border zones of granitic to syenitic composition. In places they may contain partially assimilated inclusions of biotite gneiss, amphibolite, calcsilicate gneiss, and aluminous biotite schist and gneiss; hornblende and pyroxene- rich marble xenoliths are also present in places. The uranium minerals are generally concentrated in the hybrid, commonly inclusion-bearing phases of the pegmatitic granite. Near locally mineralized, large concordant dikes, smaller satellitic dikes and veinlets cutting the immediately adjacent wall rocks may also be mineralized. Hybrid phases of the pegmatites that may contain uranium mineralization commonly exhibit some or all of the following features: (1) a red discoloration (hematitization) of the feldspars and quartz; (2) a secondary development of hornblende, pyroxene and biotite porphyroblasts as well as aggregates of smokey quartz; and (3) a late development of magnetite, iron sulphides, molybdenite, chalcopyrite, tourmaline, and fluorite-calcite aggregates either as minor disseminated grains, irregular small patches or fracture and vein fillings in the the pegmatite proper or in the immediately adjacent altered wall rocks.

In the following section, the general geology, host-rocks, and mineralization of the two largest uranium deposits in the map-area are described. These deposits, i.e., the Camindex Mines Limited deposit (3) and the Rare Earth Resources Limited deposit (16) are representative of most of the other uranium deposits in the map-area. The major features of all uranium deposits are tabulated in a subsequent section of this report along with those features of other types of mineralization in the map area (Table 5).

CAMINDEX MINES LIMITED (ZENMAC-LOON CALL LAKE) - (3)

This pegmatite-hosted uranium deposit lies along the northern flank of the Burleigh Dome, on lots 14-18, Con. I and II in southeastern Anstruther Township. Here, at the western end of Loon Call Lake, a zone of closely spaced, en echelon, pegmatitic granite dikes (Bright, 1981d) concordantly intrude a north-easterly-trending and southeast-dipping sequence of Hermon Group epiclastic metasediments and metavolcanics for a strike length of approximately 1.6 km. This zone of pegmatitic dikes is bounded on the north by a southeast-dipping fault zone that parallels the trend of both the dikes and enclosing country rocks. Shearing and fracturing related to this faulting have affected, to varying degrees, the pegmatite dikes and country rock to the south of the main fault zone along and beneath Loon Call Lake.

Diamond drilling on this property has defined four separate uranium-bearing lenses in the pegmatitic granites that, containing a combined tonnage of 406,000 tons with an average grade of 1.77 lbs U_3O_8 per ton (Assessment Files Research Office, Toronto). These lenses vary in length from 45m at the western end to 123m at the eastern end of the zone. The uranium-bearing sections of the pegmatites are deep pink to red in colour and contain more abundant mafic minerals, particularly biotite, than does unmineralized pale pink coloured, leucocratic pegmatitic granite. The uranium mineral is uranothorite (Satterly 1957) and accessory minerals reported to date are zircon, molybdenite and, in places, chalcopyrite.

RARE EARTH RESOURCES LIMITED (CAVENDISH DEPOSIT)-(16)

This pegmatite-hosted uranium deposit occurs just to the north of the map area on the S1/2 lot 14, Con. VII Canvendish Township. At the northwestern boundary of the map area, some uranium mineralization also occurs in the southern part of the host-pegmatite dike that straddles the boundary. The dike itself dips 25°-35° west, has an average thickness of 90m and can be traced about 3 km along strike to the north into the adjacent Eels Lake area (Bright, 1980, 1981b)). It intrudes the eastern flank of an overturned, south-plunging anticline in the Hermon Group strata along the southwestern flank of the Anstruther Dome.

The main shaft workings on this deposit lie immediately north of the map-area. Here, the main uranium-bearing zone occurs at the eastern, footwall contact of the pegmatite dike with mafic mineral-rich metasediments and locally metavolcanics of the Hermon Group. Mineralization is rare or absent along its western hanging wall contact with Hermon Group marbles. The main or shaft zone lies a short distance to the north of a northeasterly-trending and south-dipping thrust fault which offsets the southern end of the dike and possible also the main mineralized zone. In the map area, to the south of this fault, the pegmatite contains several small discontinuous uranium occurrences along its eastern, footwall contact. These occurrence may be the down-faulted extension of the main mineralized zone to the north of the fault. A short distance to the south of this fault, local zones of anamoulous radioactivity also occur in sheared and fractured central areas of the dike.

The unaltered central and western hanging wall contact phases of this dike are predominantly pink to white, medium- to coarse-grained, leucocratic granite with subordinate phases of pegmatitic granite. A finer-grained, graphic granite chilled margin was commonly observed along its western, hanging wall contact with the marble. Quartz throughout these parts of the dike is generally light grey and glassy, biotite seldom exceeds one percent of the rock, magnetite is seldom observed and wall rock xenoliths are not common. Near the shaft on the main mineralized zone in the vicinity of the eastern footwall, the dike is a pink to brick-red granite to pegmatitic granite containing up to 5 percent combined biotite and magnetite, particularly in those areas of the dike containing xenoliths of mafic mineral-rich country rock. The reddish colour of this altered rock is due to hematite-staining of the feldspars. The quartz varies in colour from light to medium grey and locally dark grey to black in radioactive phases. In addition to dark coloured quartz, the radioactive zones also contain abundant mafic minerals, magnetite and/or iron sulphide. Another characteristic of the footwall phases of this dike is a rapid change in grain size over short distances from medium grained to pegmatitic. In places graphic intergrowths of quartz and feldspar with quartz crystals up to 2 cm long were also observed in the footwall phases of the pegmatite.

Satterly (1957) reports that in the underground workings, the uranium-bearing zones in the footwall of the pegmatite exhibit minor to pronounced fracturing and brecciation in the following two directions:

1. northerly striking and 30°-45°W dipping-fractures, a trend subparallel to that of the dike and country rock;
2. fractures and breccia zones striking N45°-70°E and dipping 65°-90°S, a direction which parallels the author's interpreted thrust fault that offsets the host dike.

The uraniferous fracture zones at depth contain disseminated magnetite, or bands of magnetite. In the highest-grade sections, coarse magnetite forms discontinuous, 0.2-0.5m thick bands that strike north and dip 35°-45°E. Accessory minerals are zircon, allanite, titanite, anatase, uranothorite, thorite and uraninite. Uraninite, when present is closely associated with magnetite. Secondary uranium minerals present are uranophane and kasolite (Satterly, 1957). Other accessories noted by the author in strongly radioactive samples of magnetite-bearing red granite, taken from the surface dump near the capped shaft-collar, were pyrite, pyrrhotite, chalcopyrite and minor molybdenite. One of the highest scintillometer readings observed by the author was from a dump sample of coarse-grained, brick-red, leucocratic granite containing very minor biotite and no visible magnetite or iron sulphides.

Estimated reserves on the main (shaft) zone are 435,624 tons grading 1.92 lbs U_3O_8 per ton (Assessment File Research Office, Toronto).

Table 5 in the following section lists additional information on the exploration and history of development of this deposit as well as for the preceeding deposit of Camindex Mines Limited.

OTHER MINERAL DEPOSITS AND PROPERTIES

Table 5 is based on assessment work submissions and published reports on the Burleigh Falls area up to the end of 1980. All mineral deposits and properties are numbered on Map [illegible] (in back pocket). Any one number may represent more than one mineral deposit on one property.

Mineral deposits and properties are titled in this report according to ownership as of December 1980. Names in parenthesis, following titles, refer to previous owners or names by which the property is otherwise known, e.g., Rare Earth Resources Limited (Cavendish deposit).

Mineral deposits open to staking as of December 1980, are titled as occurrences and the formal name assigned to them represents the historical name or names by which they have been referred to in published reports, e.g., Louvicourt-Silanco occurrence. Properties on which no significant mineralization has been discovered or reported are titled according to the company that preformed the most work. Dates in square brackets following titles indicate the year in which the work was preformed by that company.

CONSIDERATIONS IN FUTURE EXPLORATION

BASE-METAL MINERALIZATION

The Cavendish-Harvey mafic to felsic metavolcanics in the northwestern and western part of the map area have the highest potential for base-metal mineralization. The present study indicates that metavolcanics are more extensive in Cavendish, Harvey and southeastern Galway Townships than had been previously reported by Bright (1980) and Morton (1983). Within these metavolcanics, iron sulphide occurrences containing minor chalcopyrite and occasionally minor sphalerite are more abundant in central Harvey Township than in southern Cavendish Township. The presence of a substantial volume of coarse, intermediate to felsic fragmental rocks in southwestern Cavendish, indicates that a volcanic centre may have existed nearby and that sulphide mineralization might be associated with this centre of volcanic activity. Detailed geological and geophysical exploration therefore may lead to an economic discovery in the Cavendish-Harvey volcanic sequence, and possibly also in the metavolcanics at Stoney Lake in the eastern part of the area.

URANIUM MINERALIZATION

Future exploration programs for uranium deposits or the re-evaluation of known occurrences in the map-area should concentrate on pegmatitic granite dikes and dike swarms that intrude the upper amphibolite facies rank metasediments and metavolcanics of the Hermon Group along the Harvey-Cardiff Basement Arch, in particular those sequences along and between the flanks of the Burleigh and Anstruther Domes.

Late tectonic pegmatitic granite dikes are also abundant in the Anstruther Lake Group meta-arenites that mantle the domes within the arch, however, to date no appreciable uranium mineralization has been found in the pegmatites intruding these rocks.

The same can be said for the numerous pegmatites that intrude the Mayo Group Marbles that overlie the Hermon Group strata along the margins of the Harvey-Cardiff Basement Arch in the northwestern corner and eastern part of the map-area. Hermon Group strata do occur to the east of the arch on Stoney Lake, however late tectonic pegmatites are uncommon in these rocks and no occurrences of uranium mineralization have been reported in this area.

Especially promising areas, within areas underlian by Hermon Group epiclastic metasediments and metavolcanics along the arch, are those where pegmatite dikes lie at or in close proximity to regional east to northeasterly-and northerly-trending faults. Late stage uranium remobilization and concentration during shearing and fracturing of the uraniferous host and wall rocks has been a major-ore forming process (Satterly, 1957; Hewitt, 1957).

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1) Blott, William (1977)
2) Camindex Mines Limited (Aubella occurrence)
3) Camindex Mines Limited (Zenmac-Loon Call Lake Deposit)
4) Coballoy-Silver Crater occurrence
5) Great Basin Metal Mines Limited (1969)
6) Imperial Oil Limited (1978)
7) Imperial Oil Limited (Assarco occurrence)
8) Imperial Oil Limited (Cromwell occurrence)
9) Imperial Oil Limited (Ganamede occurrence)
10) Indusmin Limited
11) Insulite Development Corporation Incorporated
12) Louvicourt-Silanco occurrence
13) Newkirk-Crab Lake occurrence
14) Newkirk-Loom Lake occurrence
15) Pole Star occurrence
16) Rare Earth Resources Limited (Cavendish deposit)
17) United Macfie occurrence

Metal and Mineral Reference

asp	Arsenopyrite
bn	Bornite
cp	Chalcopyrite
hem	Hematite
Mo	Molybdenite
Ne	Nepheline
py	Pyrite
po	Pyrrhotite
sp	Sphalerite
tour	Tourmaline
U	Uranium
Verm	Vermiculite

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Assessment Files Research Office, Ontario Geological Survey, Toronto.

Magnetic declination approximately 11°W, 1980.

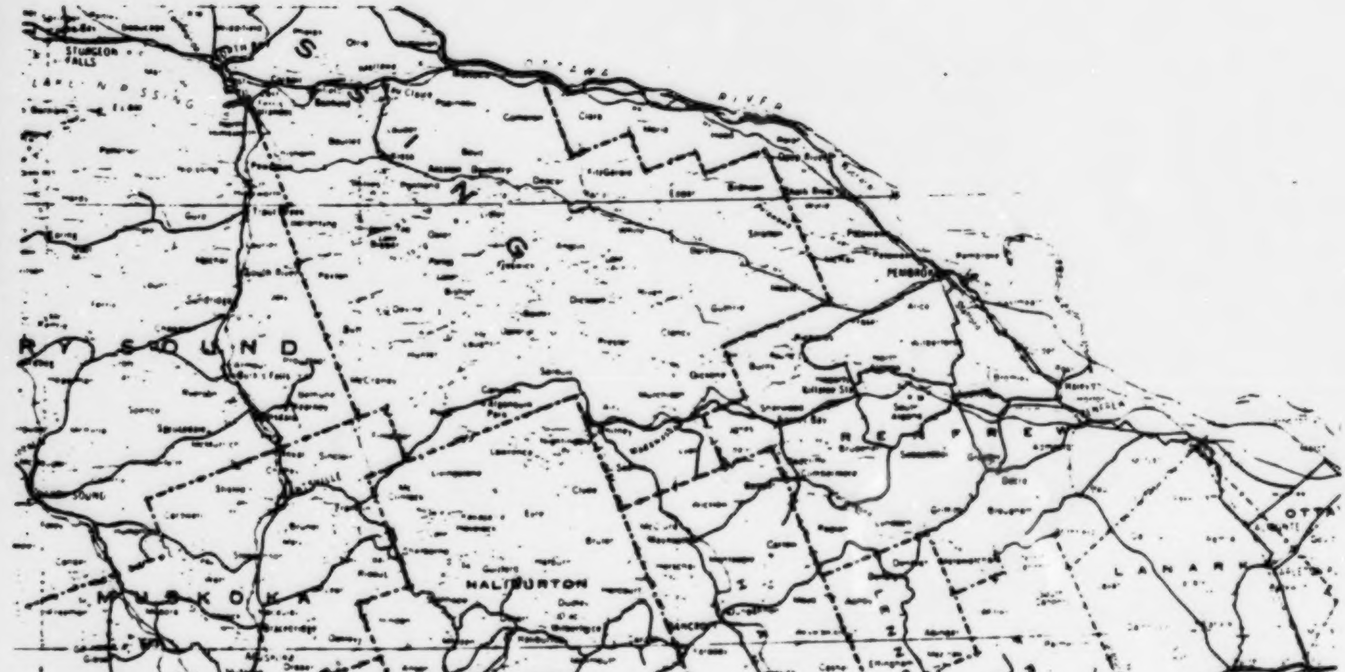
STURGEON FALLS
LAKE NIPISSING
NIPISSING
PEMBROKE
PARRY SOUND
RENFREW
HALIBURTON
MUSKOKA
LANARK
LENNOX
FRONTENAC
PETERBOROUGH
VICTORIA
LINDSAY
PETERBOROUGH
NORTHUMBERLAND
DURHAM
PRINCE EDWARD
YORK
PEEL
TORONTO
LAKE ONTARIO

Figure 1: Key map, showing location of the Burleigh Falls area.

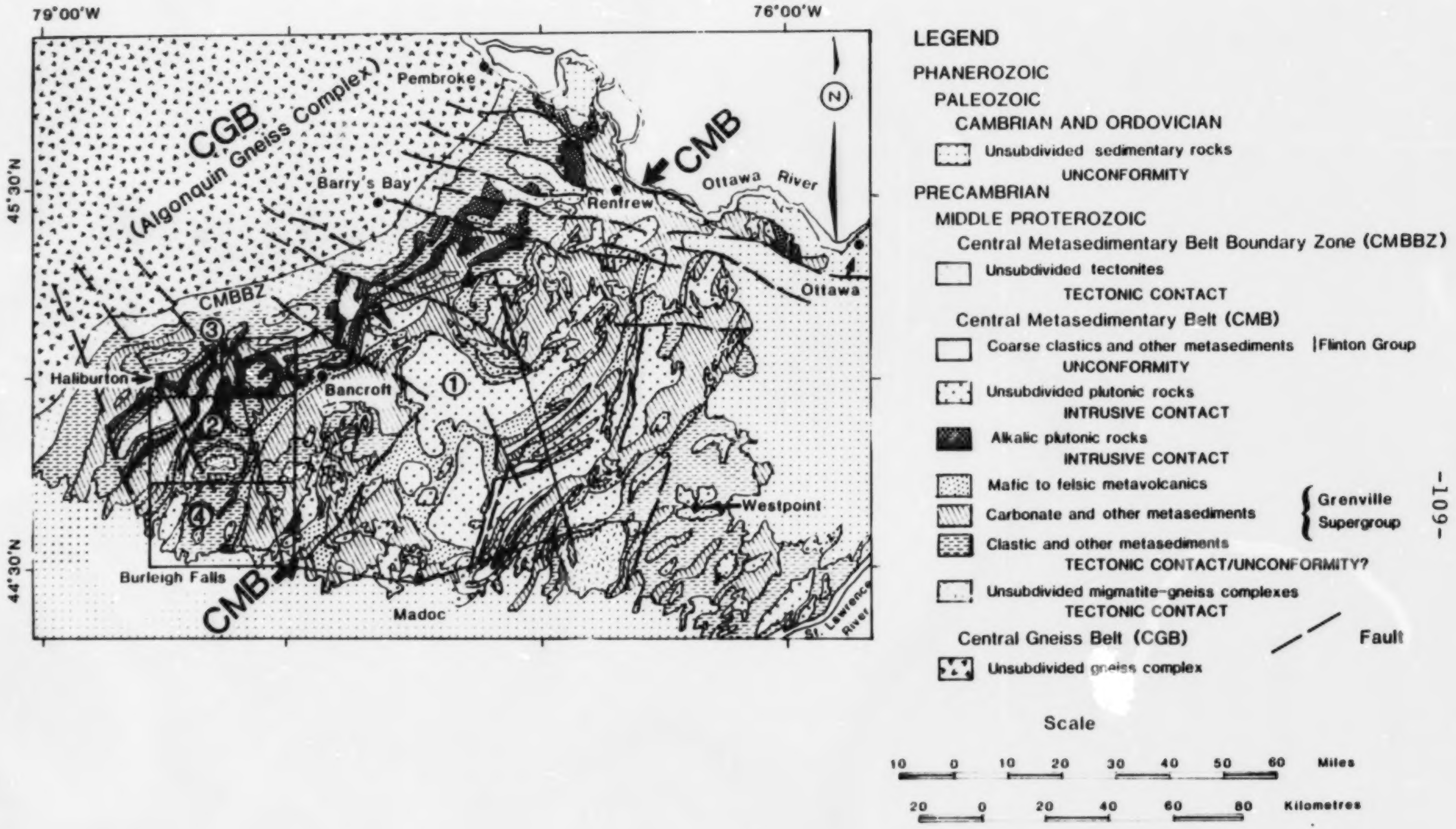
79°00'W
76°00'W
45°30'N
44°30'N
CGB
(Algonquin Gneiss Complex)
Pembroke
Barry's Bay
Renfrew
CMB
Ottawa River
Ottawa
CMBBZ
Haliburton
Bancroft
Westpoint
Burleigh Falls
Madoc
St. Lawrence River
N
①
②
③
④
LEGEND
PHANEROZOIC
PALEOZOIC
CAMBRIAN AND ORDOVICIAN
Unsubdivided sedimentary rocks
UNCONFORMITY
PRECAMBRIAN
MIDDLE PROTEROZOIC
Central Metasedimentary Belt Boundary Zone (CMBBZ)
Unsubdivided tectonites
TECTONIC CONTACT
Central Metasedimentary Belt (CMB)
Coarse clastics and other metasediments | Flinton Group
UNCONFORMITY
Unsubdivided plutonic rocks
INTRUSIVE CONTACT
Alkalic plutonic rocks
INTRUSIVE CONTACT
Mafic to felsic metavolcanics
Carbonate and other metasediments
Clastic and other metasediments
Grenville Supergroup
TECTONIC CONTACT/UNCONFORMITY?
Unsubdivided migmatite-gneiss complexes
TECTONIC CONTACT
Central Gneiss Belt (CGB)
Unsubdivided gneiss complex
Fault
Scale
10 0 10 20 30 40 50 60 Miles
20 0 20 40 60 80 Kilometres

Figure 2. Regional geology (modified after Lumbers 1978) of the southeastern Grenville Province; numbered areas are location of regional structural and stratigraphic study areas: (1) Bancroft-Madoc Area (Lumbers 1967a,b); (2) Eels Lake Area (Bright 1979, 1980); (3) Center Lake Area (Bright 1983); and (4) Burleigh Falls Area (this report).

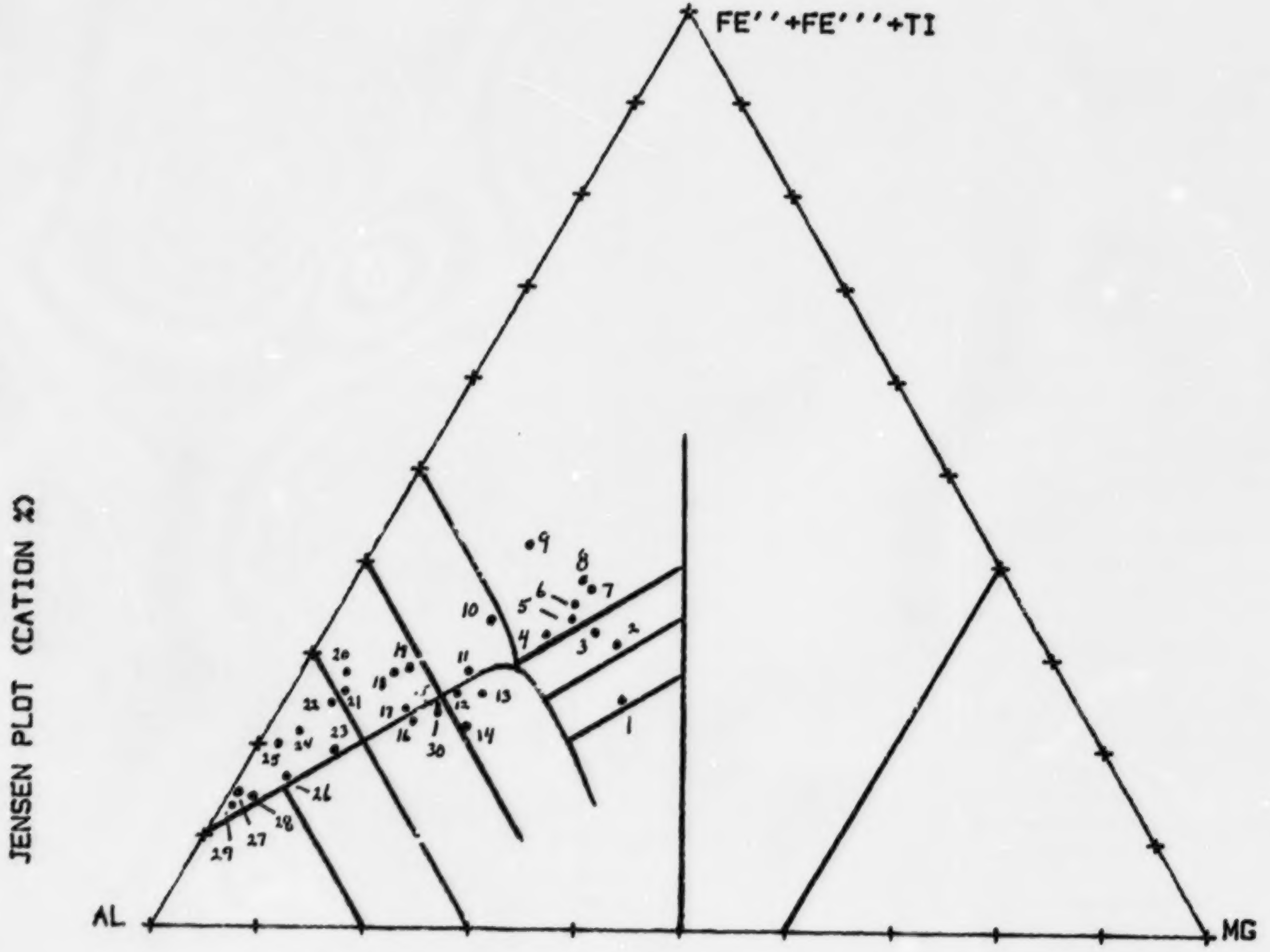

Figure 3. Projection of the major element analyses from the Cavendish-Harvey Metavolcanics (Table 2) on the Jensen Cation Diagram.

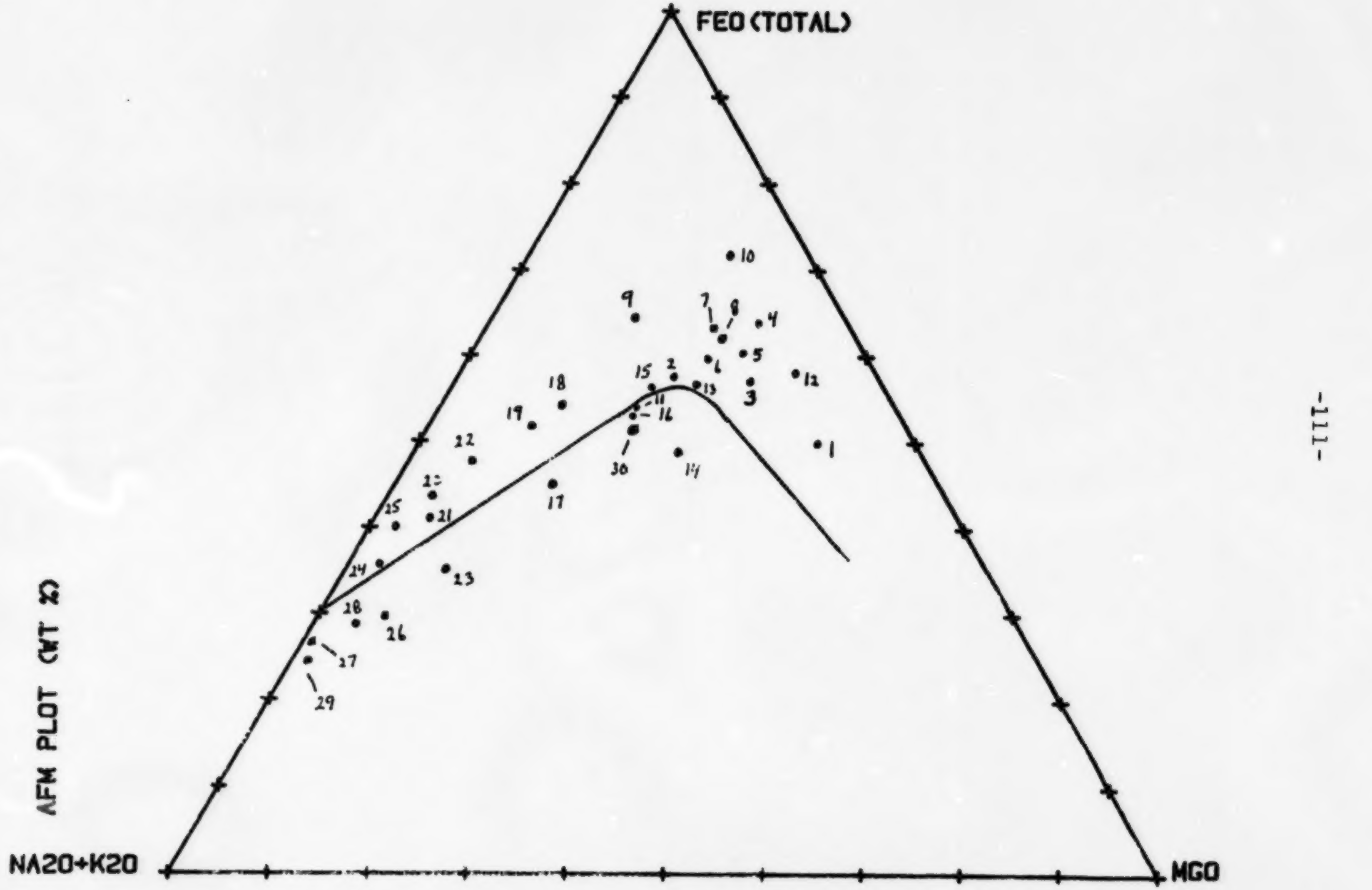

Figure 4. Projection of the major element analysis from Cavendish-Harvey Metavolcanics (Table 2) on the Irvine and Baragar AFM Diagram. The curved line serves to separate tholeiitic and calc-alkaline compositions after alkaline compositions are eliminated.

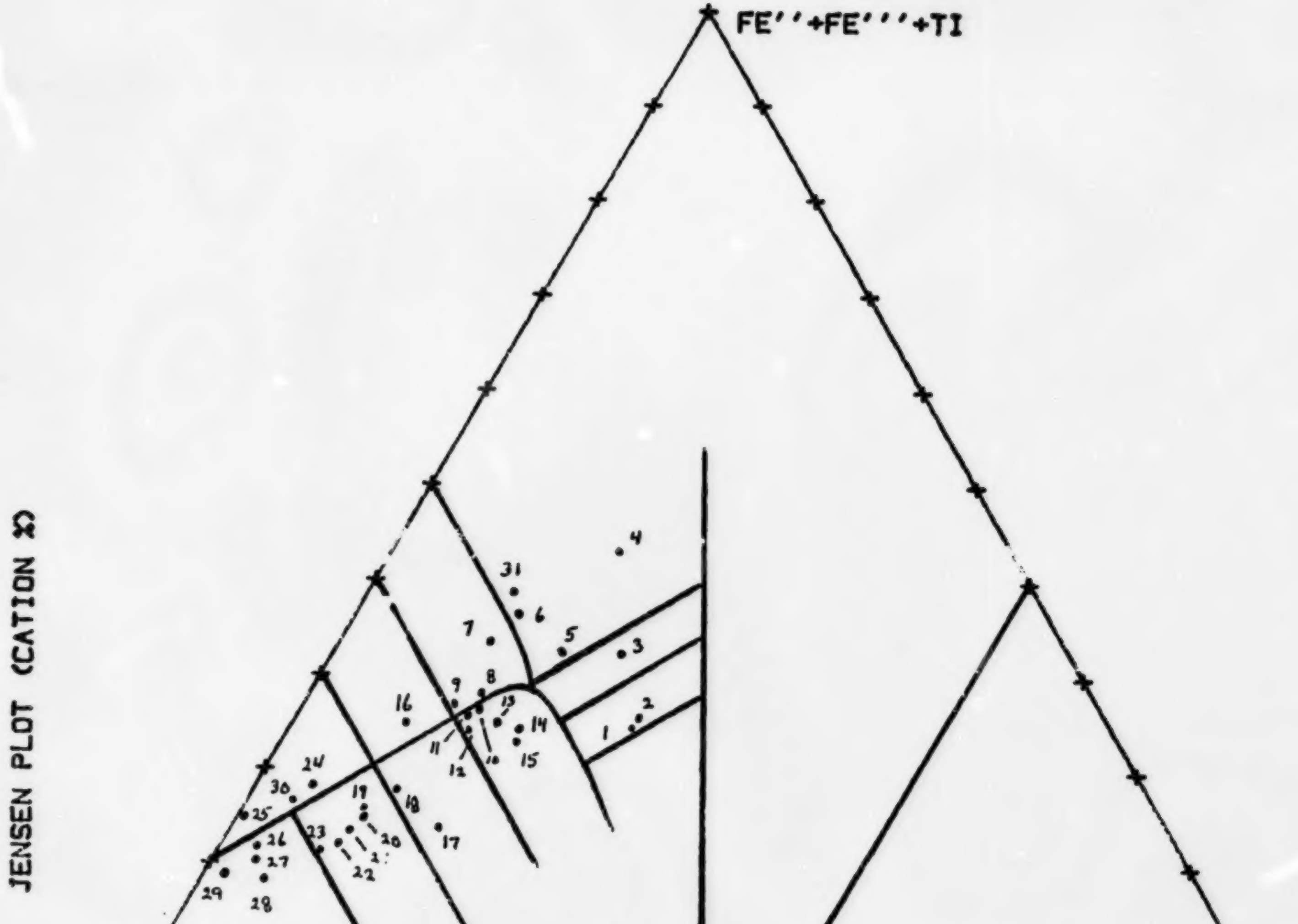

Figure 5. Projection of the major element analyses from the Stoney Lake and Loon Call Lake metavolcanics (Table 3) on the Jensen cation Diagram.

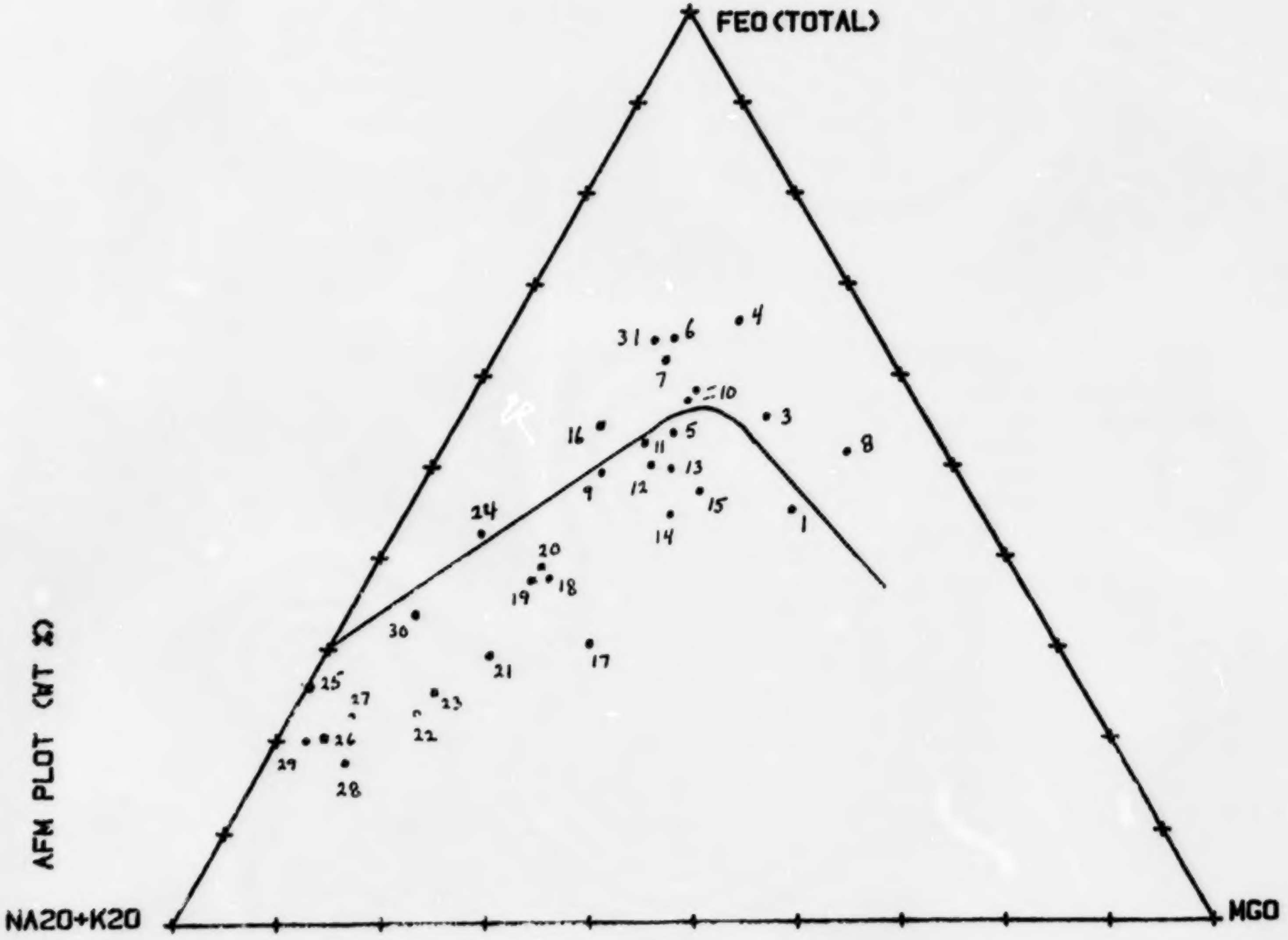

Figure 6. Projection of the major element anayses from Stoney Lake and Loon Call Lake metavolcanics on Irvine and Baragar AFM Diagram. The curve line serves to separate tholeiitic and calc-alkaline compositions after alkaline compositions are eliminated.

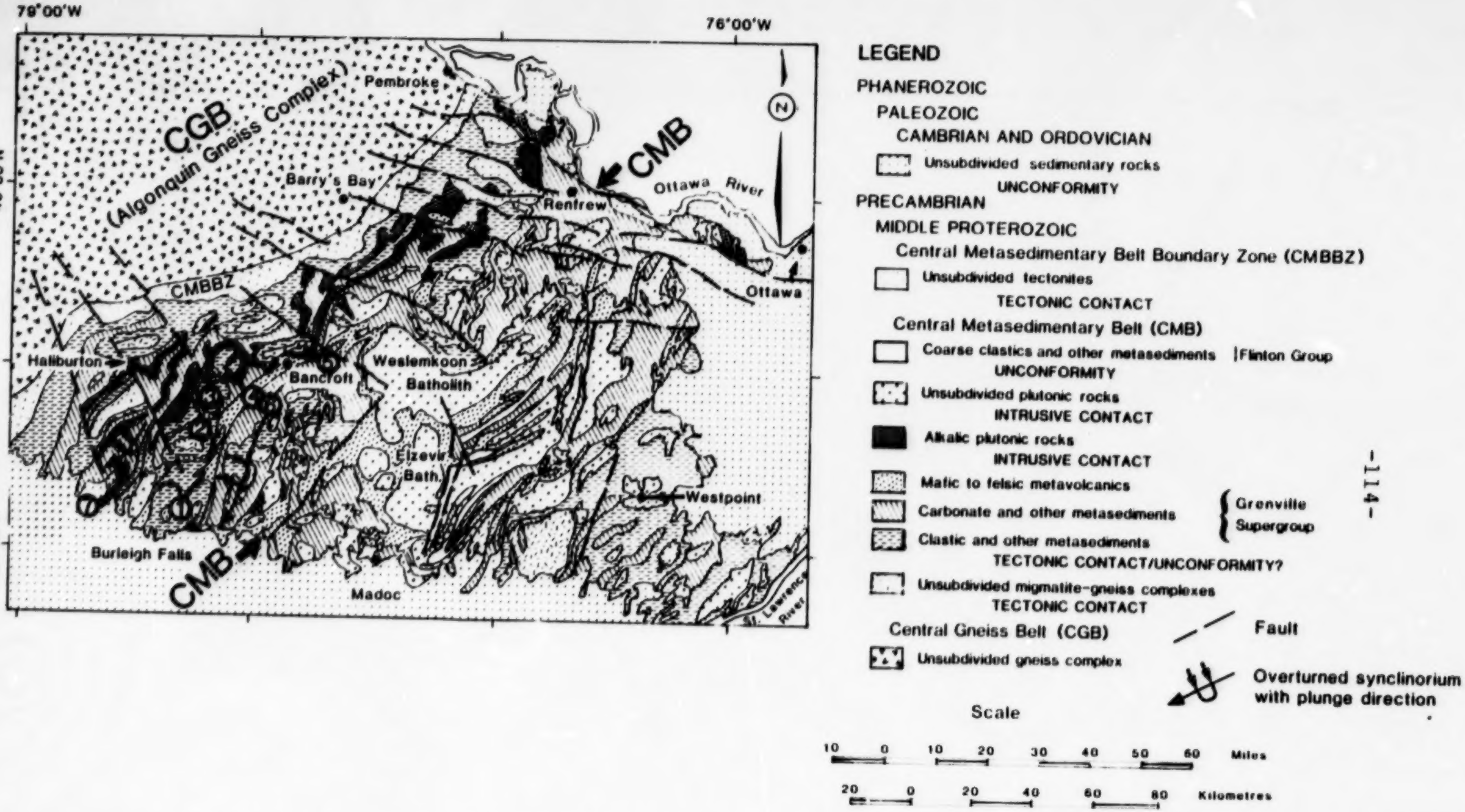
79°00'W
76°00'W
45°30'N
44°30'N
CGB
(Algonquin Gneiss Complex)
Pembroke
Barry's Bay
CMB
Renfrew
Ottawa River
Ottawa
N
CMBBZ
Haliburton
Bancroft
Weslemkoon Batholith
Elzevir Bath.
Westpoint
Burleigh Falls
Madoc
CMB
St. Lawrence River
LEGEND
PHANEROZOIC
PALEOZOIC
CAMBRIAN AND ORDOVICIAN
Unsubdivided sedimentary rocks
UNCONFORMITY
PRECAMBRIAN
MIDDLE PROTEROZOIC
Central Metasedimentary Belt Boundary Zone (CMBBZ)
Unsubdivided tectonites
TECTONIC CONTACT
Central Metasedimentary Belt (CMB)
Coarse clastics and other metasediments
Flinton Group
UNCONFORMITY
Unsubdivided plutonic rocks
INTRUSIVE CONTACT
Alkalic plutonic rocks
INTRUSIVE CONTACT
Mafic to felsic metavolcanics
Carbonate and other metasediments
Clastic and other metasediments
Grenville Supergroup
TECTONIC CONTACT/UNCONFORMITY?
Unsubdivided migmatite-gneiss complexes
TECTONIC CONTACT
Central Gneiss Belt (CGB)
Unsubdivided gneiss complex
Fault
Overturned synclinorium with plunge direction
Scale
10 0 10 20 30 40 50 60 Miles
20 0 20 40 60 80 Kilometres

Figure 7. Regional geology (modified after Lumbers 1978) of the Southeastern Grenville Province; numbered structural features along the Harvey-Cardiff Basement Arch include: (1) Burleigh Dome; (2) Anstruther Dome; (3) Cheddar Dome; (4) Cardiff Dome; and (5) Faraday Dome. Other features: (6) Chandos Synclinorium; (7) Galway Synclinorium.

Photo 1: Migmatitic feldspathic meta-arenite with thinly interlayered units of migmatitic metawacke showing one meter offset along vertical fracture; Highway 36, east of Burleigh Falls, Burleigh Township.

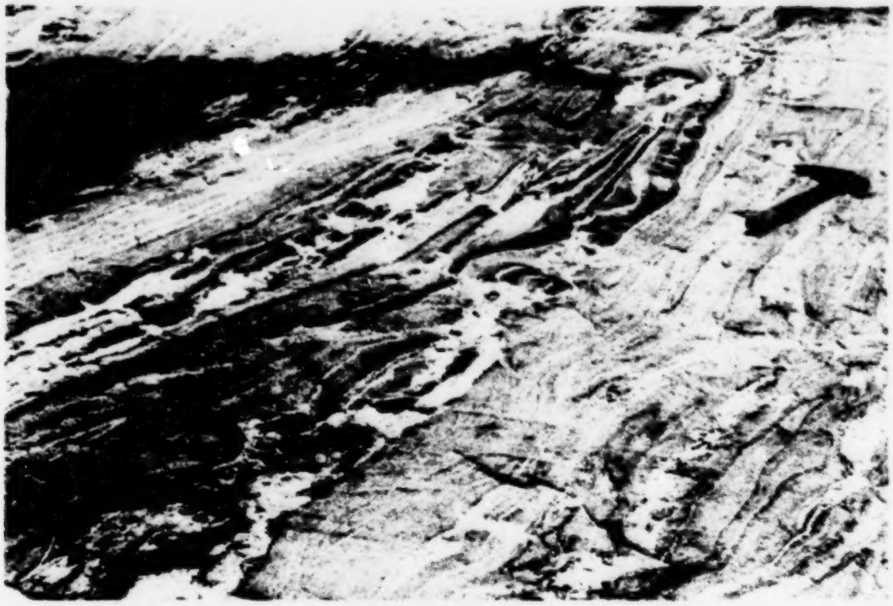

Photo 2: Intrafolia folds in thin- to medium-interlayered migmatitic metawacke and feldspathic meta-arenite; north shore of Long Lake, Burleigh Township.

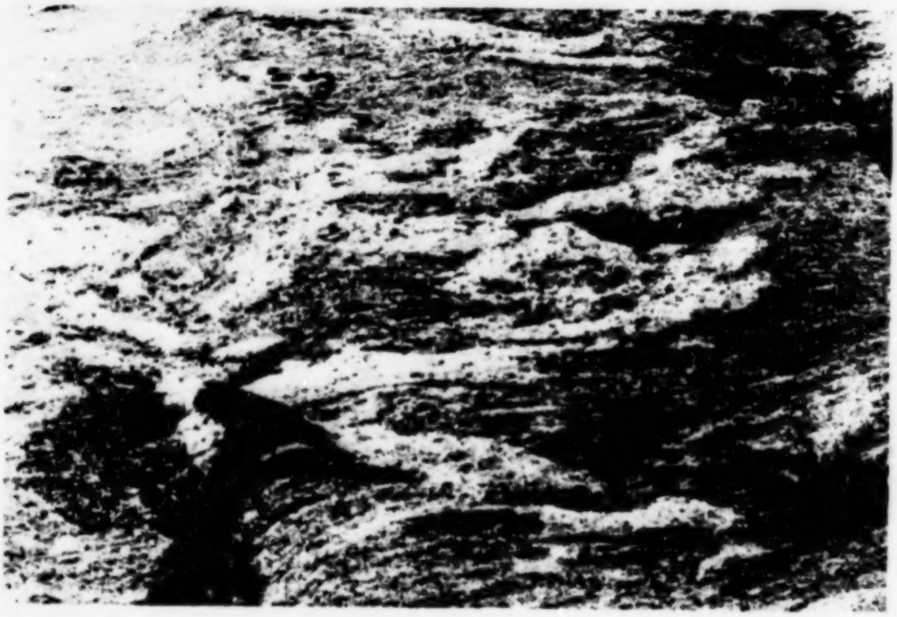

Photo 3: Nebulitic to stromatitic migmatite, an inhomogeneous diatexitic phase in migmatitic metawacke; Highway 36, east of Burleigh Falls, Burleigh Township.

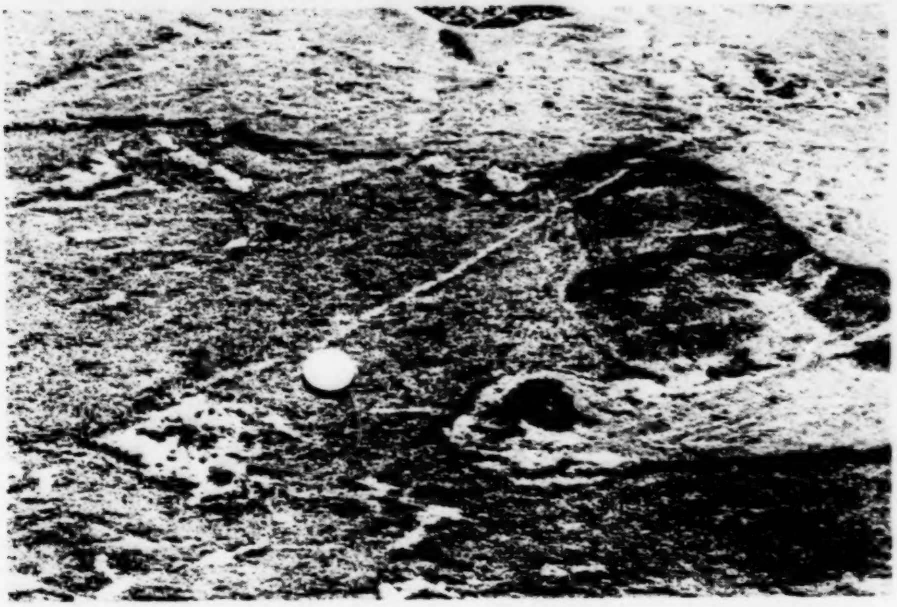

Photo 4: Stromatitic and locally nebulitic migmatite in migmatitic metawacke units; Highway 36, east of Burleigh Falls, Burleigh Township.

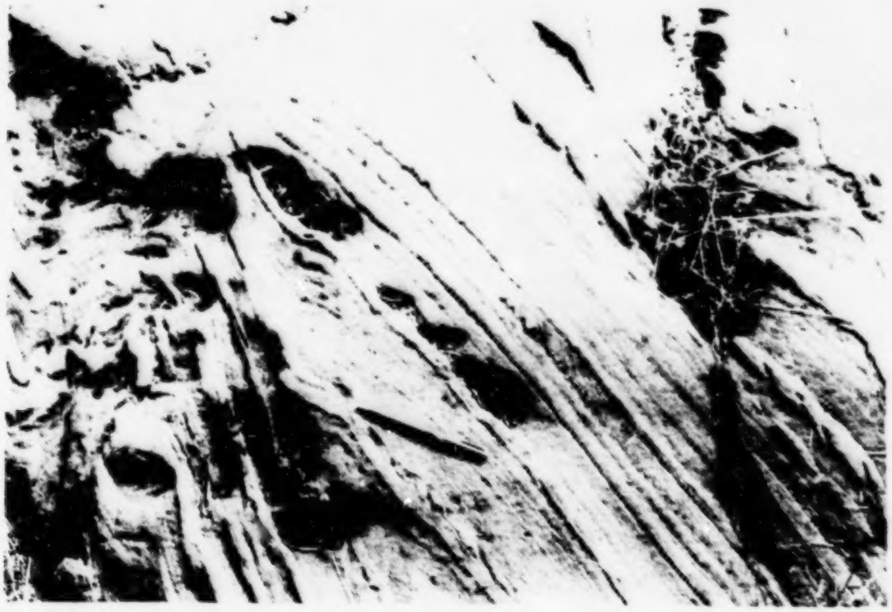

Photo 5: Deflection of cleavage traces across thinly bedded feldspathic meta-arenite sequence; South Bay at east end of Stony Lake, Burleigh Township.

Photo 6: Intermediate to felsic lapilli tuff interlayers in finely banded intermediate to felsic flow units; Highway 36 west of Highway 507, Harvey Township.

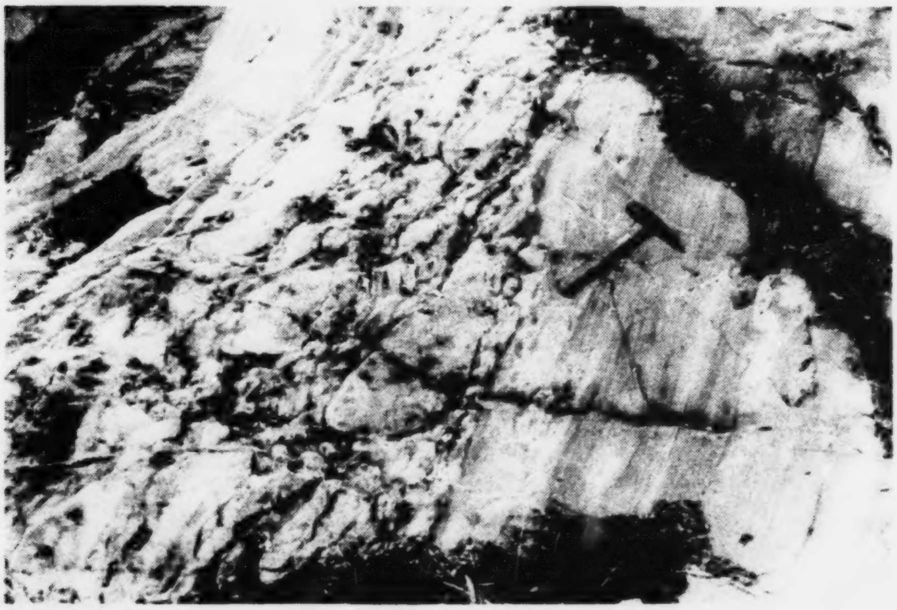

Photo 7: Interlayered intermediate to felsic lapilli-stone to tuff-breccia and finely layered tuff; west of Mississagau Lake in southwest Cavendish Township.

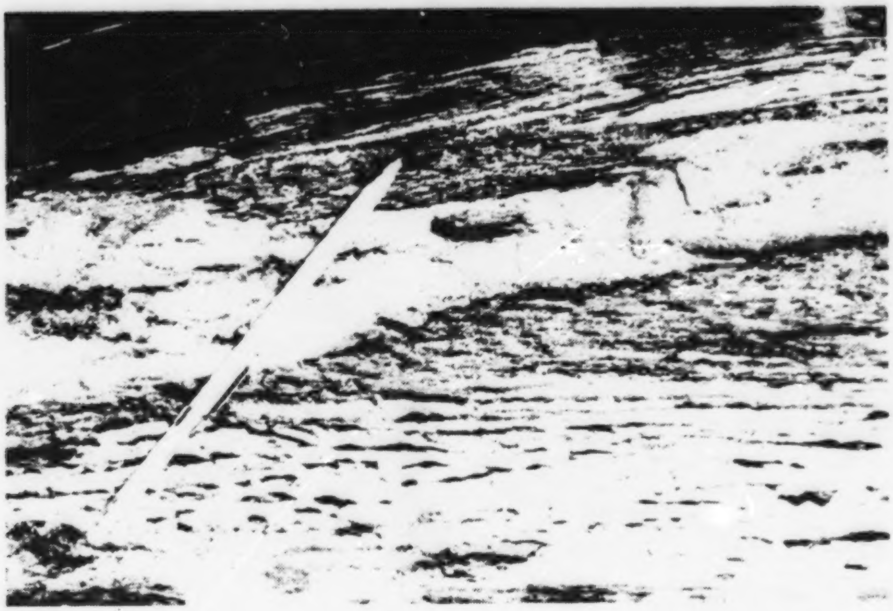

Photo 8: Intermediate to felsic lapilli-tuff interlayered with mafic to intermediate lapilli-tuff; Highway 36 west of Highway 507, Harvey Township.

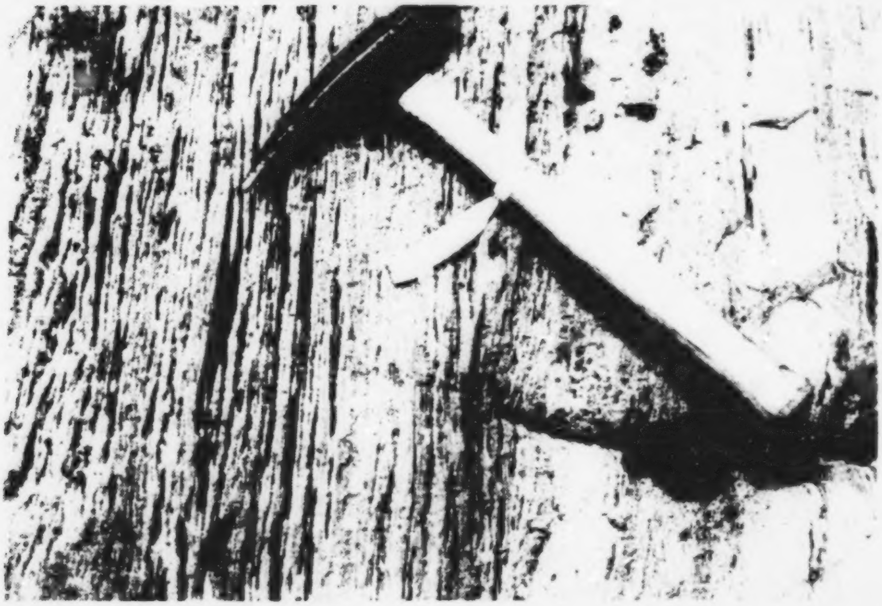

Photo 9: Interlayered intermediate to felsic ash tuff and lapilli-tuff; Highway 36, west of Squaw River, Harvey Township.

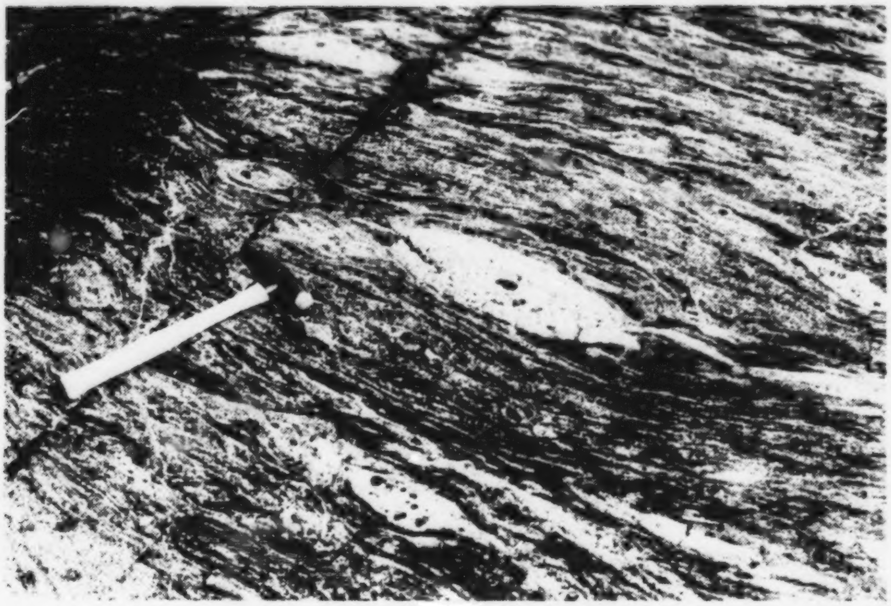

Photo 10: Interlayered intermediate to felsic lapilli-tuff and lapilli-stone; Boushing Narrows on Stoney Lake, Burleigh Township.

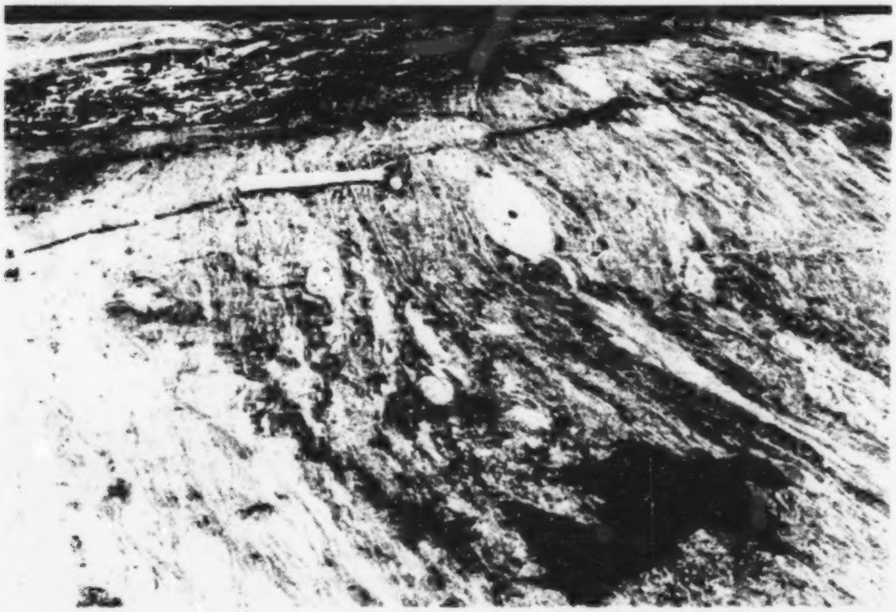

Photo 11: Interlayered intermediate to felsic lapilli-stone and mafic to intermediate lapilli-tuff and lapilli-stone; in Northey Bay on Stoney Lake, Burleigh Township.

Photo 12: Flow breccia unit, consisting of elongated, deformed amphibolite and biotite amphibolite clasts in an intermediate to felsic tuffaceous matrix adjacent to a unit containing mainly intermediate to felsic clasts in a matrix of similar composition. Northey Bay on Stoney Lake, Burleigh Township.

Photo 13: Thin to laminated bedding in fine-grained marble, locally containing interlayers of medium- to coarse-grained marble. Highway 28, north of Haultain, Burleigh Township.

Photo 14: Thin- to medium-bedded marble containing subordinate interlayers of para-amphibolite. Highway 28, north of Haultain, Burleigh Township.

Photo 15: Marble tectonic-breccia; along Eels Creek to the east of Long Lake, Burleigh Township.

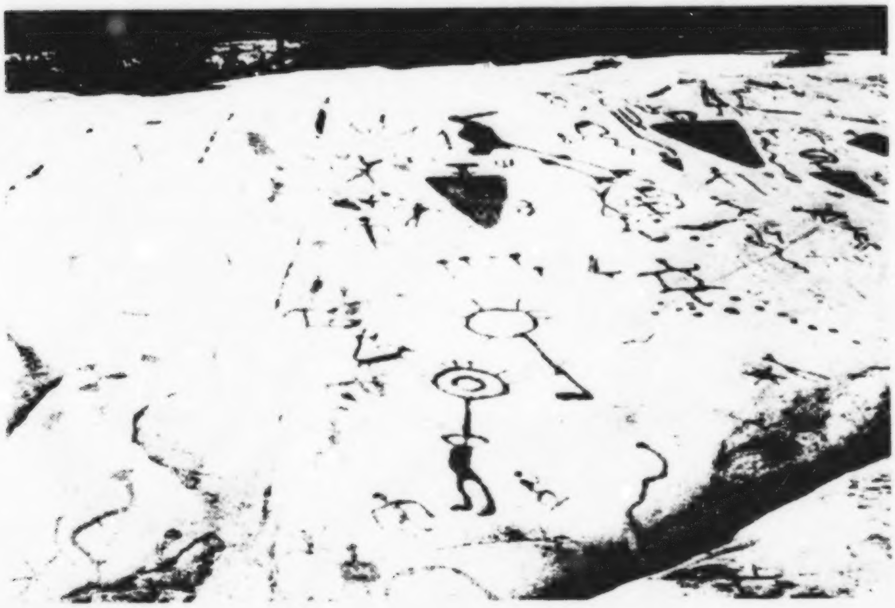

Photo 16: Indian petroglyphs in marble, enhanced by crease pencil. Petroglyph Provincial Park north of Stoney Lake, Burleigh Township.

TABLE 1 - LITHOLOGIC UNITS FOR BURLEIGH FALLS AREA

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Glaciofluvial deposits of sand, silt and gravel, locally silty to sandy and stoney till; swamp and bog accumulations.

UNCONFORMITY

PALEOZOIC

CAMBRO-ORDOVICIAN AND MIDDLE ORDOVICIAN

Basal arkosic grit, shale, siltstone and sandstone; lithographic limestone, fossiliferous limestone, bioclastic limestone, shale.

UNCONFORMITY

PRECAMBRIAN[b]

MIDDLE PROTEROZOIC

LATE PEGMATITIC GRANITIC DIKES

Leucocratic granite, pegmatitic granite, granite pegmatite

INTRUSIVE CONTACT

LATE MAFIC INTRUSIVE ROCKS

Massive to foliated, fine-grained amphibolite

dikes; massive to weakly foliated gabbro, diabase; biotite lamprophyre

INTRUSIVE CONTACT

LATE GRANITIC INTRUSIVE ROCKS .

Massive biotite granite, leucocratic granite, hornblende-biotite granite

INTRUSIVE CONTACT

METAMORPHOSED GRANITIC INTRUSIVE ROCKS

METAMORPHOSED FELSIC INTRUSIVE ROCKS

Massive to foliated, lineated, in places gneissic layered leucocratic granite, biotite granite, hornblende-biotite granodiorite; foliated, porphyritic biotite granite, hybrid granite gneiss

METAMORPHOSED INTERMEDIATE TO FELSIC INTRUSIVE ROCKSd

Foliated, in places gneissic layered biotite granodiorite, hornblende-biotite granodiorite, minor quartz diorite; foliated, in places layered leucocratic granite, biotite granite; minor quartz monzonite, hybrid granite gneiss

INTRUSIVE CONTACT

METAMORPHOSED ALKALIC INTRUSIVE ROCKS

POTASSIC SYENITE

Massive to foliated, in places gneissic layered biotite syenite, biotite-hornblende syenite, leucocratic syenite; gneissic layered hornblende-rich syenite gneiss

INTRUSIVE CONTACT

NEPHELINE SYENITE

Massive to foliated, lineated, in places gneissic layered hornblende-nepheline syenite, biotite and biotite-muscovite nepheline syenite, muscovite- and muscovite-magnetite nepheline syenite; minor nepheline syenite pegmatite dikes

INTRUSIVE CONTACT

METAMORPHOSED MAFIC INTRUSIVE ROCKS

Massive to foliated metagabbro, hornblende-plagioclase gneiss; massive to weakly foliated metadiorite, noritic metagabbro; amphibolite, metaperiodotite dikes

INTRUSIVE CONTACT

METASEDIMENTS AND METAVOLCANICS (GRENVILLE SUPERGROUP)

MAYO GROUP

EPICLASTIC METASEDIMENTS (Apsley Formation)

SILICEOUS CLASTIC METASEDIMENTS

Thinly interbedded metawacke, feldspathic meta-arenite, rusty weathering meta-arenite; minor metaconglomerate, metamudstone (biotite schist), calcareous metamudstone (para-amphibolite)

CONFORMABLE CONTACT

CHEMICAL AND EPICLASTIC METASEDIMENTS (Dungannon Formation)

CARBONATE METASEDIMENTS

Massive to foliated, layered siliceous

calcitic to dolomitic marble; locally minor thinly interlayered para-amphibolite, calc-silicate gneiss, siliceous clastic metasediments

AMPHIBOLE-RICH METASEDIMENTS

Foliated to layered para-amphibolite, biotite-hornblende and hornblende-plagioclase gneiss, calc silicate gneiss (calcareous metamudstone)

SILICEOUS CLASTIC METASEDIMENTS

Foliated, layered, in places interlayered biotite-quartz-feldspar gneiss containing less than 10 percent biotite (feldspathic meta-arenite), biotite-quartz-plagioclase gneiss, biotite schist (metawacke, metamudstone), rusty weathering quartzofeldspathic gneiss

CONFORMABLE CONTACT

HERMON GROUP

METAVOLCANICS

INTERMEDIATE TO FELSIC METAVOLCANICS[d]

Foliated, in places layered leucocratic quartzofeldspathic gneiss, biotite-and muscovite-biotite quartzofeldspathic gneiss (derived from flows or tuffs); intermediate to felsic tuff, lapillistone-tuff, tuff-breccia, coarse-grained fragmental rocks, flows

MAFIC TO INTERMEDIATE METAVOLCANICS

Foliated to layered amphibolite, hornblende-plagioclase gneiss, biotite-hornblende-quartz- plagioclase gneiss, (derived from flows or tuff); mafic to intermediate massive, amygdaloidal, porphyritic or pillowed flows; flow-breccias

CHEMICAL METASEDIMENTS

CARBONATE METASEDIMENTS

Foliated, layered siliceous calcitic to dolomitic marble; locally thinly interlayered para-amphibolite, calcsilicate gneiss, biotite-rich and feldspathic arenaceous metasediments; minor "quartzite" (meta-quartz arenite and/or recrystallized chert)

EPICLASTIC AND CHEMICAL METASEDIMENTS

IRON-RICH METASEDIMENTS

Rusty weathering quartzofeldspathic gneiss (feldspathic meta-arenite), muscovite-quartz-pyrite schist, pyritic feldspar-quartz-biotite schist; minor magnetite-bearing meta-ironstone

EPICLASTIC METASEDIMENTS

ALUMINOUS METAMUDSTONES

Garnet-sillimanite-biotite schist and gneiss, garnet- biotite schist, garnet-biotite-muscovite schist and gneiss

AMPHIBOLE-RICH METASEDIMENTS

Foliated, layered amphibolite, biotite amphibolite, hornblende-plagioclase gneiss, calcsilicate gneiss (calcareous metamudstone)

BIOTITE-RICH METASEDIMENTS

Foliated, layered, in places migmatitic biotite quartz-plagioclase gneiss (metawacke), hornblende-biotite and biotite-hornblende-quartz-plagioclase gneiss (calcareous metawacke), biotite schist (metamudstone); minor metaconglomerate, feldspathic arenaceous metasediments

FELDSPATHIC, ARENACEOUS METASEDIMENTS

Foliated, layered, in places migmatitic biotite-quartz-feldspar gneiss containing less than 10 percent biotite (feldspathic meta-arenite), muscovite-biotite-quartz-feldspar gneiss; minor interlayered biotite-rich metasediments; units of thinly interbedded feldspathic meta-arenite, rusty weathering feldspathic meta-arenite, metawacke, locally interbedded clast- to matrix supported meta-quartzarenite- and polymictic pebble metaconglomerate, minor marble

CONFORMABLE CONTACT

ANSTRUTHER LAKE GROUP

EPICLASTIC METASEDIMENTS AND RELATED MIGMATITES

BIOTITE-RICH METASEDIMENTS

Foliated and layered, biotite-quartz-plagioclase gneiss, hornblende-biotite-quartz-plagioclase gneiss (metawacke); migmatitic varieties of metawacke containing less than 10 percent granitoid leucosome layers; minor biotite schist (metamudstone); minor interlayered feldspathic arenaceous metasediments; minor foliated, in places stromatic, nebulitic and schollenitic biotite migmatite

FELDSPATHIC ARENACEOUS METASEDIMENTS

Foliated, in places layered biotite-quartz-feldspar gneiss containing less than 10 percent biotite (feldspathic meta-arenite); migmatitic varieties of meta-arenites containing less than 10 percent granitoid leucosome layers; minor biotite-rich metasediments; minor foliated, in places stromatitic quartzofeldspathic migmatite

UNCONFORMITY

BASEMENT MIGMATITE-GNEISS COMPLEX

Foliated, in places stromatic pinkish-grey quartzofeldspathic migmatite, grey biotite migmatite; nebulitic biotite migmatite, foliated, in places layered granodioritic gneiss

MAPS
NOT
FILMED

CARTES
OMISES